Heritability of neuropsychological measures in schizophrenia and non-psychiatric populations: A systematic review and meta-analysis

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Schizophrenia is characterized by neuropsychological deficits across many cognitive domains. Cognitive phenotypes with high heritability and genetic overlap with schizophrenia liability can help elucidate the mechanisms leading from genes to psychopathology. We performed a meta-analysis of 170 published twin and family heritability studies of >800 000 nonpsychiatric and schizophrenia subjects to accurately estimate heritability across many neuropsychological tests and cognitive domains. The proportion of total variance of each phenotype due to additive genetic effects (A), shared environment (C), and unshared environment and error (E), was calculated by averaging A, C, and E estimates across studies and weighting by sample size. Heritability ranged across phenotypes, likely due to differences in genetic and environmental effects, with the highest heritability for General Cognitive Ability (32%– 67%), Verbal Ability (43%–72%), Visuospatial Ability (20%–80%), and Attention/Processing Speed (28%–74%), while the lowest heritability was observed for Executive Function (20%–40%). These results confirm that many cognitive phenotypes are under strong genetic influences. Heritability estimates were comparable in nonpsychiatric and schizophrenia samples, suggesting that environmental factors and illness-related moderators (eg, medication) do not substantially decrease heritability in schizophrenia samples, and that genetic studies in schizophrenia samples are informative for elucidating the genetic basis of cognitive deficits. Substantial genetic overlap between cognitive phenotypes and schizophrenia liability (average $r_g = -.58$) in twin studies supports partially shared genetic etiology. It will be important to conduct comparative studies in well-powered samples to determine whether the same or different genes and genetic variants influence cognition in schizophrenia patients and the general population.

Introduction

There is extensive evidence that cognition is significantly impaired in schizophrenia. Relative to healthy individuals, schizophrenia patients as a whole have a generalized impairment across many cognitive functions, demonstrated by meta-analyses of over 200 schizophrenia neuropsychological studies.[1,2] At the individual patient level, 75%–100% of patients exhibit cognitive impairments, depending on the method of classifying deficits.[3] A meta-analysis by Mesholam-Gately and colleagues[4] of neuropsychological functioning in first episode schizophrenia patients showed that, in the early stages of disease when the brain is less affected by antipsychotic medications, performance across several cognitive domains is impaired on average 0.91 SDs below the healthy control mean. Individuals at clinical high-risk for psychosis are less impaired than first episode patients, although there are greater deficits in high risk individuals who later develop a full psychotic illness than those who do not.[5,6] In addition, unaffected family members at genetic risk for developing the disorder have poorer cognition compared to unaffected individuals without a family history of schizophrenia.[7–10] Cognitive deficits are relatively unimproved by antipsychotic medications and consequently have a substantial impact on the functional outcome of patients.[11–17] Elucidating the molecular mechanisms underlying cognition is essential for identifying novel targets for the development of new treatments that improve cognitive functioning in patients with schizophrenia.

Recent advances in the field of psychiatric genetics have led to the identification of a large number of common genetic variants that confer risk for schizophrenia.[18–27] Determining how these risk variants contribute to brain-based phenotypes that are abnormal in schizophrenia, such as cognitive deficits, can greatly contribute to our understanding of the biological pathways leading from risk genes to disease. A prerequisite for such studies is evidence that the phenotypes are heritable and have a genetic basis that overlaps with that of schizophrenia liability.[28–30] Measures of General Cognitive Ability are highly heritable ($h2$ > 65%),[31,32] although there is less consistent evidence for heritability of measures indexing specific cognitive domains. Toulopoulou, Owens and colleagues estimated from a series of twin studies that genetic correlations between cognitive measures and liability of schizophrenia range between −.09 and −1.00, averaging −.58,[33–38] indicating that a substantial proportion of the variance in cognition and schizophrenia liability is due to common genetic factors.

We performed a systematic review of twin- and family-based heritability studies of cognitive phenotype sin schizophrenia and non psychiatric populations with several objectives in mind. Given the lack of available quantitative studies, we performed meta-analyses of data available for many neuropsychological tests and cognitive domains to determine the best estimates ofheritability. We determined whether studies of nonpsychiatricindividuals and schizophrenia patients differin heritability to examine whether, as claimed, heritability in patients is lower due to environmental factors and illness-related moderators, such as higher rates of smoking and substance use, fluctuations in medication, or clinical state during testing.[39–41] Further, as family studies cannot disentangle genetic and shared environmental sources of phenotypic variance, we compared variance component estimates from family and monozygotic/ dizygotic (MZ/DZ) twin study designs.

Methods

Detailed methods are provided in the supplementary material.

Data Collection

A literature search performed in PubMed and PsycINFO resulted in >2000 papers published prior to January 2016. Following abstract review, identification of additional articles from the reference lists, and exclusion of studies according to pre-established criteria (supplementary methods, supplementary tables 1–4), 170 empirical articles describing twin or family studies were includedin the analyses (supplementary figure 1). These studiesinvestigated the heritability of >600 neuropsychologicaltest variables in 64 independent cohorts (supplementary tables 1, 5–8). See supplementary material for a complete list of references included in the meta-analyses.

Statistical Analyses

We performed separate meta-analyses for studies of nonpsychiatric twins (129 studies), nonpsychiatric families (13), and schizophrenia families (22). We meta-analyzed neuropsychological test variables that were reported in at least 2 independent studies. Additionally, neuropsychological test variables were assigned to one of the following 11 domains based on prior meta-analyses[2,4] of cognition in schizophrenia: General Cognitive Ability, Attention/ Processing Speed, Attention/Vigilance, Working Memory, Verbal Learning and Memory, Nonverbal Learning and Memory, Executive Function, Verbal Ability, Visuospatial Ability, Motor Skills, and Social Cognition. Metaanalyses of cognitive domains utilized all tests within a domain regardless of how many studies analyzed a particular test variable. If multiple tests within a cognitive domain were available for a given cohort, we included the average

estimates for additive genetic effects (A), common (shared) environment (C), as well as unique (unshared) environment and error (E) across those tests in the domain meta-analysis. Supplementary Table 9 describes the tests included in this meta-analysis, the cognitive functions they assess, and the cognitive domains they index.
For each neuropsychological test or cognitive domain, the proportion of total variance accounted for by A, C, and E was calculated by averaging each component across studies from independent cohorts while weighting by sample size. Family studies without twins cannot distinguish the influences of A and C, therefore the estimate of familiality (A+C) was used as A. Heritability was calculated as the proportion of total variance due to additive genetic effects (A / A+C+E). All analyses were carried out in R (http://www.r-project.org) using custom scripts.
Wald tests[42] were applied to identify significant differences in the heritability of domain were available for a given cohort, we included the average estimates for additive genetic effects (A), common (shared) environment (C), as well as unique (unshared) environment and error (E) across those tests in the domain meta-analysis. Supplementary table 9 describes the tests included in this meta-analysis, the cognitive functions they assess, and the cognitive domains they index.
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Results

Twin correlations as indicators of heritability

Supplementary Figure 2 illustrates that non-psychiatric MZ twin correlations for cognitive phenotypes averaged 0.6 (range 0-0.95), while DZ twin correlations averaged 0.2 (range 0.25-0.80), suggesting sizeable influences of A and E, and minor influences of C. General Cognitive Ability had the highest MZ/DZ correlation ratios (mean r_{MZ} / r_{DZ} = 0.75 / 0.44), indicating that a large proportion of the variation can be attributed to A, consistent with reports of high heritability.[43] Although more variable, ratios for Verbal Ability and Visuospatial Ability were also high (0.66 / 0.40 and 0.55 / 0.30).

Meta-analyses of heritability of cognitive phenotypes

Non-psychiatric twins. The studies of non-psychiatric twins aged >16 (Supplementary Table 5) reported 375 test variables from all 11 cognitive domains. Of these, 48 variables from 8 domains were studied in 2–11 independent cohorts and meta-analyzed. Heritability estimates ranged between 20% and 80% (Figure 1). High heritability (h^2) was observed for measures of General Cognitive Ability (h^2=53%) and the Index Scores obtained from the Wechsler Adult Intelligence Scale (WAIS) (h^2=53–80%), as well as WAIS Digit Symbol Coding (h^2=59%) and Arithmetic (h^2=58%), and the Educational Testing Service (ETS) tests (h^2=67–74%). Overall, the cognitive domain showing the highest heritability was Visuospatial Ability (h^2=51%), followed by Verbal Ability (h^2=41%) and Attention/Processing Speed (h^2=45%), primarily driven by the high heritability of the WAIS subtests within each of these three domains. *Non-psychiatric families.* The family studies of non-psychiatric individuals (Supplementary Table 6) reported 64 test variables from 10 of the 11 cognitive domains (except Motor Skills), of which 9 variables were studied in 2–3 independent family cohorts and meta-analyzed. Heritability estimates ranged from 30 to 55% (Figure 2). Heritability was high for measures of General Cognitive Ability (h^2=53%), as well as the IQ subtest scores of WAIS Letter-Number Sequencing (h^2=55%) and WAIS Matrix Reasoning (h^2=53%). Overall, the individual cognitive domains showing the highest heritability were Visuospatial Ability (h^2=52%), which was primarily driven by the high heritability of Matrix Reasoning, and Verbal Ability (h^2=52%).

Schizophrenia families. The family studies of schizophrenia (Supplementary Table 7) reported 142 test variables from all 11 cognitive domains, of which 41 variables were studied in 2–7 independent cohorts and meta-analyzed. Heritability estimates ranged from 15 to 74% (Figure 3). Heritability was high for measures of General Cognitive Ability (h^2=63%) and WAIS Vocabulary (h^2=74%), as well as WRAT Reading (h^2=74%), often used as a proxy measure for premorbid IQ. Furthermore, high heritability was apparent for the Wechsler Memory Scale (WMS) subtest Logical Memory Immediate Recall, CVLT Long Delay Free Recall, Penn Word Memory, WAIS Block Design and Similarities, and Judgment of Line Orientation (h^2=52%–62%). Overall, the cognitive domain showing the highest heritability was Verbal Ability (h^2=55%), followed by Visuospatial Ability (h^2=51%), again driven mostly by the high heritability of the WAIS subtests within each domain.

Supplementary Figures 3-13 show heritability data from individual studies included in the metaheritability estimates. The forest plots show the heritability of individual neuropsychological test variables and the overarching cognitive domains. The resulting meta-estimates of individual tests (bold) and domains (bold italic) correspond to the data in Figures 1 to 3.

In summary, twin and family studies show highest heritability for the following tests: WAIS Digit Symbol Coding, Letter-Number Sequencing, Digit Span, Vocabulary, Information, and Block Design, as well as ETS Hidden Patterns and Identical Pictures, and Thurstone Picture Memory.

Heritability estimates do not substantially differ between schizophrenia and non-psychiatric samples

Comparison of heritability estimates from schizophrenia and non-psychiatric samples indicated that cognitive phenotypes do not have lower heritability in patients, in contrast to what has been thought due to environmental factors and illness-related moderators. Figure 4 shows the results from each study design for phenotypes that were meta-analyzed in the non-psychiatric twin and at least one other study design. Of the 15 phenotypes available in both schizophrenia and non-psychiatric family studies, 13 phenotypes did not significantly differ in heritability. Attention/Processing Speed had significantly lower heritability and Semantic Fluency had significantly higher heritability in schizophrenia families compared to non-psychiatric families (Wald test p=3.5x10^{-4} and p=3.9x10^{-5}). However, the difference in Semantic Fluency may not be accurate, as it was driven by low heritability in non-psychiatric families based on only two studies. Heritability estimates also did not markedly differ between 15 phenotypes available in non-psychiatric twin and family designs, with only WAIS Digit Symbol Coding and Semantic Fluency having significantly lower heritability in families than twins (Wald test p=7.3x10^{-6} and p=1.0x10^{-3}). The confidence intervals of the heritability estimates were typically narrower for phenotypes with larger numbers of studies and larger total sample sizes, as expected. **Taking the sample sizes into account, heritability estimates appeared equally precise for schizophrenia and non-psychiatric studies.**

Genetic overlap between schizophrenia liability and cognition

To assess the genetic overlap between schizophrenia liability and cognitive functions, we summarized data reported in the Maudsley Twin and Family Studies and by the overarching Schizophrenia Twins and Relatives Consortium (STAR Consortium),[44] a series of studies of twins and other family members concordant or discordant for schizophrenia (Supplementary Table 8).[33-38] Figure 5 shows the cross-twin-cross-trait correlations, i.e., the correlations between phenotype 1 in co-twin 1 and phenotype 2 in co-twin 2, and vice versa.[36, 37] Significantly larger cross-twin-cross-trait correlations for MZ twin pairs ($rMZ_{CT\text{-}CT}$) than for DZ twins ($rDZ_{CT\text{-}CT}$) resulted in greater genetic overlap (r_g) with schizophrenia liability, as noted for verbal and non-verbal memory measures (Logical Memory [-0.34 to - 0.58], Verbal Paired Associates [-0.26 to -0.50], and Visual Reproduction [-0.34 to -0.99]), Full-scale IQ (-0.46 to -0.69), and WAIS Index Scores (-0.34 to -0.79), which are major components of IQ. Some cognitive phenotypes had very high genetic correlations, (r_g>0.8, Trail Making Test A and B, Semantic Fluency) which may be overestimations since the confidence intervals for those correlations were relatively wide (Supplementary Table 8). The genetic overlap between cognitive phenotypes and schizophrenia liability ranged widely, possibly due to small samples causing imprecise estimates, but overall was relatively high (average r_g = -0.58; SD = 0.22).

Discussion

This study reports a comprehensive meta-analysis of heritability data across cognitive domains in non-psychiatric individuals and those with schizophrenia. We confirm the high heritability of multiple cognitive domains and demonstrate that this applies to both schizophrenia and non-psychiatric samples. To our knowledge, this is the first systematic, meta-analytic demonstration that the heritabilities of cognitive phenotypes in schizophrenia are equivalent to those in healthy populations.

The most heritable phenotypes (h^2 >64%) were IQ, Spearman's 'g', and some WAIS index scores that comprise IQ (Verbal Comprehension, Perceptual Organization), as well as tests that comprise or are highly correlated with IQ, such as WAIS Vocabulary and Block Design (h^2=57-60%). Interestingly, phenotypes within the Attention/Processing Speed domain differed substantially in heritability, with measures indexing information processing speed (e.g., Digit Symbol Coding, ETS Hidden Patterns) having relatively high heritability (h^2=59-74%), and timed measures dependent on motor response having lower heritability (h^2=28-50%). For the most part, tests that we considered indexes of executive functioning (e.g., Wisconsin Card Sorting Test, Tower of London) had relatively low heritability (h^2=20-40%). Given the multifactorial nature of neuropsychological tests, our categorization of tests into cognitive domains is not the only possible arrangement. For example, Stroop Interference and Trail Making Test B could be grouped in the Executive Function domain instead of the Attention/Processing Speed domain; however, doing so would not increase the Executive Function heritability estimate since the heritability of these tests was also low. Thus, we provided individual test data in the tables to enable evaluation of test-specific heritability estimates, in addition to domain estimates.

The fact that we report substantial heritability across cognitive phenotypes has important implications. While high heritability does not indicate that any particular gene has a large effect on the phenotype, it does suggest that the phenotype has a sizeable genetic component that improves precision for defining gene function in cognition. The range in heritability across phenotypes could result from differences in genetic architecture, where different genes and/or the same genes with different effects (possibly due to different genetic variants) mediate the phenotypes. Alternatively, differences in environmental effects or measurement error between phenotypes could affect heritability, since heritability is a *proportion* of the total phenotypic variance, which also comprisesvariance due to common environment (C), and unique environment and measurement error (E). Measurement error is likely not a major factor, however, since test-retest reliability is generally high (intra-class correlations >0.7) for most neuropsychological tests. An exception is executive function tasks that tend to have low reliability[49, 50] (e.g., intra-class correlations <0.7 for WCST indices). This might be due to their sensitivity to practice effects,which may explain their relatively low heritability in our meta-analyses. In contrast, environmental factors have substantial influences on some cognitive phenotypes; for example, verbal tests are particularly sensitive to education and socioeconomic status. In reality, both genetic and environmental factors likely underlie the range in heritability observed across the cognitive phenotypes. An important implication is that cognitive phenotypes with similar degrees of genetic effects could differ in heritability due to different environmental effects, a notion that is typically not appreciated by heritability studies, which tend to invoke genetic explanations for heritability differences.

The current study also compared heritability between schizophrenia and non-psychiatric study designs and did not find consistent differences. This is perhaps the most important and novel finding of this study, and has several important implications. First, similar heritability suggests that genetic factors contributing to schizophrenia do not disrupt normal genetic influences on cognition in the general population. Second, it suggests that schizophrenia and non-psychiatric samples should be equally informative for genetic studies of cognition. Third, similar heritability indicates The current study also compared heritability between schizophrenia and non-psychiatric study designs and did not find consistent differences. This is perhaps the most important and novel finding of this study, and has several important implications. First, similar heritability suggests that genetic factors contributing to schizophrenia do not disrupt normal genetic influences on cognition in the general population. Second, it suggests that schizophrenia and non-psychiatric samples should be equally informative for genetic studies of cognition. Third, similar heritability indicates that illness-related moderators (e.g., medication, higher rates of smoking and substance use in patients) and environmental factors, which are often assumed to have larger effects in schizophrenia samples, have negligible effects on heritability. However, the lack of marked differences between schizophrenia and non-psychiatric samples in the measurement accuracy of neuropsychological tests[46-48] suggests that fluctuations in illness-related moderators have negligible effects on cognitive performance. While there is some evidence that illness-related moderators affect some cognitive domains,[55 56-59] two large cohort studies did not find consistently higher variances in several cognitive phenotypes in schizophrenia patients compared to healthy subjects (e.g., BACS composite score, Continuous Performance Test, CVLT, Letter-Number Sequencing).[60-63] Also, we found similar confidence interval widths for heritability estimates of cognitive phenotypes across schizophrenia and non-psychiatric samples, indicating that heritability in schizophrenia samples is fairly consistent despite differences in environmental factors and illness related moderators (due to differences in ascertainment, inclusion/exclusion criteria, etc.). Therefore, the degree to which genetic studies of cognition in schizophrenia will be informative for elucidating the biology and informing novel treatment approaches for cognitive impairment will depend on the variance explained by genetic factors (i.e., the heritability), rather than illness related moderators and environmental factors. This is an important issue because it is commonly thought that environmental factors and illness-related moderators hinder the detection of genetic effects in schizophrenia samples. For this reason, some studies have focused on unaffected relatives of patients, who carry genetic risk for schizophrenia and have impaired cognition (although less severe than patients),[9, 64, 65] but lack or have milder illness-related moderators, as a means to examine the genetics of cognition in schizophrenia. Instead, similar heritability suggests that studying schizophrenia samples is valuable and, some might argue, more informative for understanding the relationship between cognition and schizophrenia.

Some cognitive domains that are impaired in schizophrenia[1, 4] are relatively understudied genetically, particularly Social Cognition, Attention/Vigilance, Non-Verbal Memory, and Executive Function. Fewer studies and smaller sample sizes can lead to inaccurate heritability estimates that may explain, in part, the low heritability observed for some of these domains. Heritability could be inaccurate in family studies since they do not distinguish influences of genetic effects (A) and common environment (C); therefore, these influences are combined into “familiality”. However, the lack of consistent differences in heritability using a family design compared to the MZ/DZ twin design suggests that C has negligible influence on most cognition phenotypes. Thus, for family studies, A+C is almost entirely A, and “familiality” is a good proxy for heritability.

An emerging method to estimate heritability utilizes population-based SNP data to determine the collective variance in a phenotype that is explained by common genetic variation (e.g., [66, 67]). SNP-based heritability of cognitive phenotypes in adults is estimated to be 29% for general cognitive ability (Spearman's '*g*')[68] and 19-56% for other cognitive phenotypes.[69-74] These estimates are lower than those from our meta-analyses, but in line with a twin study that reported considerably lower heritability estimated from SNP data than from variance components.[71] This 'missing heritability' suggests that other inherited factors not indexed by SNPs, such as rare variants and structural variation, as well as heritable epigenetic modifications and other factors, contribute to individual variation in cognitive phenotypes[75]. It will be important to develop analytical methods that incorporate other potential sources of genetic variation to estimate heritability using population-based approaches.

We also examined the genetic overlap between cognitive phenotypes and schizophrenia liability from a summary of schizophrenia twin studies.[33-38] We found moderate to high genetic correlations **(average $r_g = -0.58$),** consistent with a previous report of significant correlations between several cognitive domains and negative symptoms and disorganization.[76] **However, the twin study genetic correlations ranged widely across phenotypes, possibly due to small samples causing imprecise estimates, or because some cognitive constructs have stronger genetic relationships to schizophrenia than others.** The genetic overlap suggests that shared genes regulate neurodevelopmental processes mediating both cognition and psychosis.[77] **Alternatively, the genes may have pleiotropic effects reflecting multiple roles in neural processes that govern cognition and other mechanisms underlying schizophrenia.** In an attempt to assess causality between cognition and schizophrenia liability, Toulopoulou et al.[38] performed multivariate structural equation modeling in schizophrenia twinfamily samples and found evidence that cognitive deficits lie upstream of liability, with a genetic correlation of -0.51. Population-based studies also support genetic overlap of cognition with schizophrenia liability, although possibly lower (e.g., genetic correlation of -0.26)[78] than that estimated by schizophrenia studies. Molecular genetic overlap between cognition and schizophrenia is supported by recent GWAS mega-analyses.[19, 79-81] Specifically, polygenic variation influencing cognitive functioning in healthy cohorts was significantly associated with schizophrenia case status in independent datasets.[19] In parallel, polygenic risk for schizophrenia was significantly associated with poorer cognition in healthy cohorts.[79-81] These studies suggest that polygenic variants influencing schizophrenia risk modulate neural processes involved in cognition in the general population, although the **contribution is small (explaining <1% variance in cognition).[79-81] It is conceivable that schizophrenia genetic factors have a stronger impact on cognition in patients, possibly because dysfunctional neural circuits are more sensitive to the genetic effects than normally functioning circuits. Unfortunately, the few patient studies examining schizophrenia genetic variants in cognition produced inconsistent results, possibly due to small sample sizes.[82-84] In addition, there have been no studies specifically examining the genetic basis of the degree of cognitive impairment in patients separate from the genetic basis of cognitive ability. While schizophrenia risk genes may influence the degree of impairment, as suggested by the presence of cognitive deficits in unaffected relatives genetically predisposed to schizophrenia, [9, 64, 65] other genes that are not causal in schizophrenia may be involved. Indeed, the partial genetic overlap between cognition and schizophrenia liability indicates that genes not involved in schizophrenia also have a substantial influence on cognition.**

It is unclear whether cognition genes have the same effects in schizophrenia and nonpsychiatric populations, or whether the effects differ despite heritability being similar. While there has been considerable effort to elucidate the genetic architecture of cognition in non-psychiatric populations,[43, 68, 79, 85] there is a dearth of high-powered genetic studies of cognition in schizophrenia samples. Analyses of large, well-phenotyped samples consisting of both patients and healthy individuals, which we

are actively undertaking, will be important to clarify this issue. If the same genes influence cognition in schizophrenia patients and the general population, the neural mechanisms regulated by these genes may nonetheless operate differently in patients, perhaps due to genetic variation associated with cognitive impairment. A similar genetic basis in schizophrenia and non-psychiatric populations would not invalidate cognitive markers as endophenotypes of schizophrenia, since cognitive deficits in patients meet the criteria for endophenotypes notwithstanding.[28] Cognition is a particularly important endophenotype because delineating its underlying genetic mechanisms may identify promising targets for improving cognitive functioning in patients.

At this time, it is difficult to recommend specific neuropsychological tests or cognitive domains that are the most appropriate for examining the genetic basis of cognition in schizophrenia. This judgment depends on both the heritability of the phenotype and its genetic overlap with schizophrenia. Our meta-analyses identified several cognitive phenotypes having high heritability, such as IQ, Spearman's 'g', and WAIS index scores mentioned above, which could be prioritized for genetic studies. However, the genetic correlation data from twin studies are too limited to conclusively identify phenotypes having the largest genetic overlap with schizophrenia. Similarly, analyses of the effects of schizophrenia risk genes and polygenic factors across multiple cognitive phenotypes are limited, although two recent studies reported that polygenic risk explains more variance in Attention/Language than Verbal Memory,[81] and Performance IQ than Verbal IQ and Full-Scale IQ.[80] Additional studies are required to determine which cognitive phenotypes have the strongest genetic relationships to schizophrenia and are most appropriate as markers for studying the genetics of cognition in schizophrenia.
Recent studies have also identified genetic overlap of cognitive phenotypes with brain structuralphenotypes.[38] Further, the heritability of specific cognitive abilities is comparable to the heritability of volume and cortical thickness of brain structures subserving those abilities,[86, 87] many of which involve the prefrontal cortex. Schizophrenia onset during adolescence and early adulthood coincides with the maturation of brain regions that are abnormal in schizophrenia, such as the temporal and frontal lobes.[88-90] Indeed a putative mechanism underlying schizophrenia might be mistiming of brain maturation processes that are important for higher order cognitive functions.[91] Brain maturational stages would therefore be important to consider when interpreting genetic relationships between schizophrenia and cognition or other phenotypes. It would also be important to consider sex differences in cognitive deficits given known sexual dimorphism in normal neurodevelopmental processes and their timing, as well as those associated with schizophrenia.[92]

Conclusions

Taken together, our results show that most cognitive phenotypes have moderate to high heritability, although estimates range widely, **likely due to differences in both genetic and environmental influences.** Our results also indicate that heritability of cognitive phenotypes does not markedly differ between schizophrenia and non-psychiatric populations, **suggesting that schizophrenia samples are valuable for studying the genetic basis of cognitive impairment in patients. Genetic overlap between schizophrenia and cognitive phenotypes supports a shared genetic etiology; however, more studies are required to verify whether the same genes influence cognitive variation in schizophrenia patients and the general population.**

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Figure Legends

Figure 1. Variance component estimates for cognitive phenotypes based on meta-analysis of non-psychiatric twin studies.
Percentage variance explained by A (Additive genetic influences), C (Common environment), and E (Unique environment and Error) for individual test variables (plain font) and cognitive domains (bold font). Error bars and numbers in parentheses indicate 95% confidence intervals. The sample size for a given cognitive domain differs from the summed sample size for test variables within that domain because inclusion criteria differ (see Supplementary Methods).

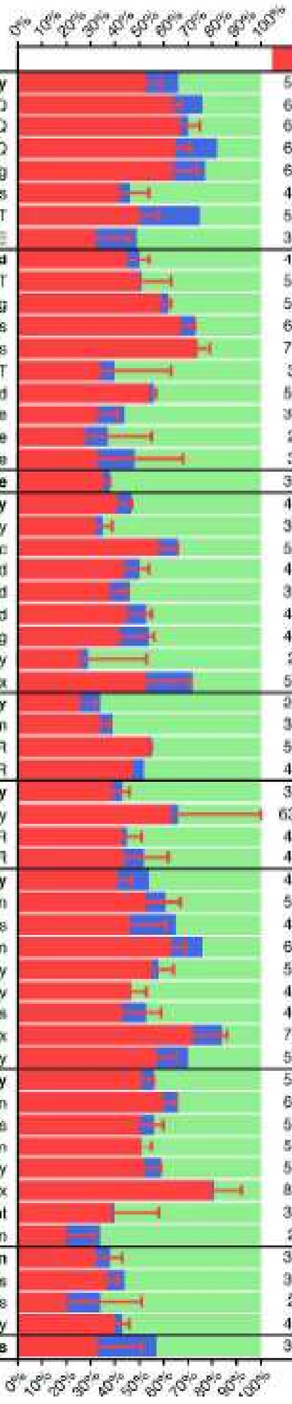
Figure 2. Variance component estimates for cognitive phenotypes based on meta-analysis of non-psychiatric family studies.
Percentage variance explained by A + C (Additive genetic + Common environment influences) and E (Unique environment and Error) for individual test variables (plain font) and cognitive domains (bold

font). A and C are combined because they cannot be disentangled in the family design. Error bars and numbers in parentheses indicate 95% confidence intervals. The sample size for a given cognitive domain differs from the summed sample size for test variables within that domain because inclusion criteria differ (see Supplementary Methods).

Figure 3. Variance component estimates for cognitive phenotypes based on meta-analysis of schizophrenia family studies.
Percentage variance explained by A + C (Additive genetic + Common environment influences) and E (Unique environment and Error) for individual test variables (plain font) and cognitive domains (bold font). A and C are combined because they cannot be disentangled in the family design. Error bars and numbers in parentheses indicate 95% confidence intervals. The sample size for a given cognitive domain differs from the summed sample size for test variables within that domain because inclusion criteria differ (see Supplementary Methods).

Figure 4. Heritability of cognitive phenotypes across study designs.
Phenotypic variance explained was determined by meta-analysis for non-psychiatric twin, non-psychiatric family, and schizophrenia family studies, or from the original study estimates for schizophrenia twin studies. Cognitive domains (bold) and test variables (plain) meta-analyzed in the non-psychiatric twin and at least one other study design are shown. Error bars indicate 95% confidence intervals. *$p<0.05$ (Bonferroni-corrected). WCST = Wisconsin Card Sorting Test; CVLT = California Verbal Learning Test; IR, DR = Immediate, Delayed Recall.

Figure 5. Genetic overlap between cognitive phenotypes and schizophrenia liability based on twin data.
Cross-twin cross-trait (CT-CT) correlations for cognition in co-twin 1 and schizophrenia liability in cotwin 2 for MZ pairs ($r\mathrm{MZ}_{\mathrm{CT\text{-}CT}}$) and DZ pairs ($r\mathrm{DZ}_{\mathrm{CT\text{-}CT}}$). r_{ph} is the total phenotypic correlation between the cognitive phenotype and schizophrenia liability, of which $r_{\mathrm{ph\text{-}a}}$ is the amount due to additive genetic influences. r_{g} is the genetic correlation between the cognitive phenotype and schizophrenia liability. All correlations are negative (e.g., poor cognition associated with high liability) but are shown as positive values for plotting consistency. Data are maximum likelihood estimates reported in [34-37]. Study reference numbers are shown in parentheses. CT-CT correlations were only reported for studies [36] and [37]. FIQ and WMS subtests were analyzed in multiple studies; only data from studies reporting CT-CT correlations are shown. See Supplementary Table 8 for all reported data. IR, DR = Immediate, Delayed Recall; WAIS = Wechsler Adult Intelligence Scale; WMS = Wechsler Memory Scale.



	A	C	E	Studies	Subjects
General Cognitive Ability	53 (47-59)	13 (9-16)	34 (28-41)	25	47,890
Full-scale IQ	64 (61-67)	12 (9-16)	24 (21-28)	9	17,120
Performance IQ	67 (59-75)	3 (0-6)	30 (25-35)	6	4,880
Verbal IQ	65 (60-71)	17 (12-22)	18 (16-20)	6	4,880
Spearman's g	64 (54-74)	13 (6-21)	23 (16-30)	10	9,582
Raven's Progressive Matrices	42 (30-54)	4 (1-6)	54 (45-64)	6	16,104
AFQT	50 (41-58)	25 (16-34)	25 (25-26)	2	7,644
MMSE	32 (19-46)	17 (8-27)	51 (45-56)	4	3,442
Attention/Processing Speed	45 (37-54)	5 (1-9)	50 (42-57)	18	9,339
Choice RT Mean RT	50 (37-63)	1 (0-3)	49 (34-62)	4	2,752
WAIS Digit Symbol Coding	59 (56-63)	3 (0-7)	38 (35-41)	11	6,080
ETS Hidden Patterns	67 (62-73)	6 (2-9)	27 (19-36)	2	1,416
ETS Identical Pictures	74 (70-79)	0 (0-0)	26 (21-30)	3	1,784
Simple RT Mean RT	34 (5-63)	6 (0-16)	60 (39-79)	3	1,300
Stroop Color-Word	54 (50-57)	2 (0-4)	44 (43-46)	2	588
Stroop Interference	33 (25-41)	11 (4-19)	56 (44-67)	3	1,812
Trail Making Test A Time	28 (0-55)	9 (0-28)	63 (53-72)	2	656
Trail Making Test B Time	33 (0-68)	15 (0-43)	52 (45-59)	2	590
Attention/Vigilance	35 (32-38)	3 (0-7)	62 (58-67)	4	3,564
Working Memory	41 (36-47)	6 (3-9)	53 (47-58)	20	11,223
Spatial 2-back Accuracy	32 (24-39)	3 (0-10)	65 (52-80)	2	1,446
WAIS Arithmetic	58 (51-66)	8 (4-12)	34 (26-41)	6	3,028
WAIS Digit Span Backward	44 (35-54)	6 (0-12)	50 (44-55)	5	2,870
WAIS Digit Span Forward	38 (30-45)	8 (0-17)	54 (47-61)	6	4,396
WAIS Digit Span Forward + Backward	45 (35-55)	8 (4-12)	47 (40-54)	8	4,140
WAIS Letter-Number Sequencing	42 (29-56)	12 (1-23)	46 (43-48)	2	1,750
SDRT Accuracy	26 (0-53)	3 (0-9)	71 (49-92)	2	1,730
WAIS Working Memory Index	53 (36-71)	19 (0-37)	28 (19-37)	3	2,168
Verbal Memory	26 (20-32)	8 (6-10)	66 (61-71)	9	16,815
CVLT Trials 1-5 Sum	34 (29-38)	5 (0-11)	61 (51-71)	2	1,704
WMS Logical Memory DR	54 (53-55)	1 (0-2)	45 (44-45)	4	1,934
WMS Logical Memory IR	47 (47-47)	5 (3-8)	48 (45-50)	2	1,910
Non-Verbal Memory	39 (32-46)	4 (1-7)	57 (49-65)	8	6,354
Thurstone Picture Memory	63 (27-100)	3 (0-7)	34 (0-74)	2	2,316
WMS Visual Reproduction DR	43 (34-51)	2 (1-3)	55 (48-63)	2	1,448
WMS Visual Reproduction IR	44 (27-62)	8 (1-15)	48 (39-57)	2	1,910
Verbal Ability	41 (34-47)	13 (10-16)	46 (40-53)	21	24,530
WAIS Comprehension	53 (39-67)	8 (1-14)	39 (26-49)	4	1,964
DSB Synonyms	46 (31-61)	19 (8-29)	35 (31-40)	2	1,730
WAIS Information	63 (56-69)	13 (5-21)	24 (20-27)	7	4,626
Phonemic Fluency	55 (47-64)	3 (0-8)	42 (36-46)	6	2,008
Semantic Fluency	47 (40-53)	0 (0-0)	53 (47-60)	4	2,788
WAIS Similarities	43 (28-59)	10 (3-16)	47 (33-60)	4	1,964
WAIS Verbal Comprehension Index	72 (59-86)	12 (0-23)	16 (12-20)	3	2,168
WAIS Vocabulary	57 (48-65)	13 (7-18)	30 (22-39)	8	4,856
Visuospatial Ability	51 (45-56)	5 (2-8)	44 (40-49)	15	9,361
WAIS Block Design	60 (55-65)	6 (2-10)	34 (27-41)	8	5,056
ETS Card Rotations	50 (39-60)	6 (2-11)	44 (36-52)	3	1,134
HFDO Mental Rotation	51 (46-56)	0 (0-0)	49 (45-52)	3	1,606
WAIS Object Assembly	52 (45-59)	7 (2-11)	41 (37-60)	5	2,964
WAIS Perceptual Organization Index	80 (67-92)	1 (0-3)	19 (8-32)	3	2,168
WAIS Picture Arrangement	39 (20-58)	1 (0-2)	60 (41-76)	4	1,964
WAIS Picture Completion	20 (8-32)	14 (4-25)	65 (52-80)	4	1,964
Executive Function	32 (22-43)	6 (2-11)	62 (51-72)	7	4,513
WCST Perseverative Errors	37 (32-41)	7 (3-12)	56 (56-56)	2	958
WCST Perseverative Responses	20 (0-51)	14 (0-30)	68 (51-82)	2	386
WCST Trials to 1st Category	40 (34-46)	3 (1-5)	57 (49-64)	2	958
Motor Skills	33 (16-51)	24 (17-31)	43 (33-52)	2	1,852

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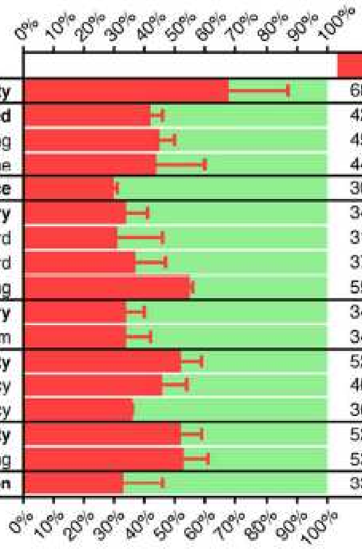

	A+C	E	Studies	Subjects
General Cognitive Ability	68 (49-87)	32 (13-51)	3	11,707
Attention/Processing Speed	42 (39-46)	58 (54-61)	6	8,722
WAIS Digit Symbol Coding	45 (40-50)	55 (50-60)	3	7,532
Trail Making Test B Time	44 (29-60)	56 (40-71)	3	2,206
Attention/Vigilance	30 (28-31)	70 (69-72)	2	1,426
Working Memory	34 (26-41)	66 (59-74)	3	4,650
WAIS Digit Span Backward	31 (17-46)	69 (54-83)	2	4,493
WAIS Digit Span Forward	37 (28-47)	63 (53-72)	2	4,493
WAIS Letter-Number Sequencing	55 (53-56)	45 (44-47)	2	1,426
Verbal Memory	34 (27-40)	66 (60-73)	6	11,766
CVLT Trials 1-5 Sum	34 (25-42)	66 (58-75)	3	2,206
Verbal Ability	52 (45-59)	48 (41-55)	5	8,530
Semantic + Phonemic Fluency	46 (38-54)	54 (46-62)	3	6,528
Semantic Fluency	36 (36-36)	64 (64-64)	2	2,049
Visuospatial Ability	52 (45-59)	48 (40-55)	3	1,359
WAIS Matrix Reasoning	53 (44-61)	47 (39-56)	2	1,286
Executive Function	33 (20-46)	67 (54-80)	3	1,484

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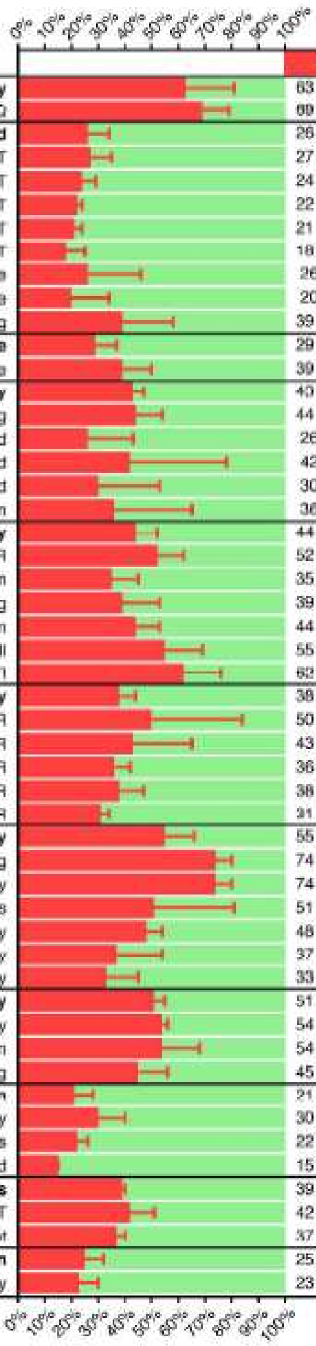

	A+C	E	Studies	Subjects
General Cognitive Ability	63 (45-81)	37 (19-55)	5	2,139
Full-scale IQ	69 (60-79)	31 (21-40)	3	1,822
Attention/Processing Speed	26 (18-34)	74 (66-82)	9	3,947
CNB JOLO RT	27 (20-35)	73 (65-80)	2	1,957
CNB PCET RT	24 (20-29)	76 (71-80)	2	1,947
CNB Penn Face Memory RT	22 (20-24)	78 (76-80)	2	1,968
CNB Penn Word Memory RT	21 (18-24)	79 (76-82)	2	1,950
CNB VOLT RT	18 (11-25)	82 (75-89)	2	1,935
Trail Making Test A Time	26 (6-46)	74 (54-94)	4	661
Trail Making Test B Time	20 (7-34)	80 (66-93)	5	778
WAIS Digit Symbol Coding	39 (19-58)	61 (42-81)	5	1,663
Attention/Vigilance	29 (20-37)	71 (63-80)	6	3,566
CPT-Degraded Stimulus d-prime	39 (27-50)	61 (50-73)	2	1,151
Working Memory	43 (38-47)	57 (50-62)	10	6,101
WAIS Letter-Number Sequencing	44 (34-54)	56 (46-66)	4	2,750
WAIS Digit Span Backward	26 (9-43)	74 (57-91)	3	616
WAIS Digit Span Forward	42 (7-78)	58 (22-93)	3	616
WAIS Digit Span Forward + Backward	30 (8-53)	70 (47-92)	3	288
WMS Spatial Span	36 (6-65)	64 (35-94)	2	301
Verbal Memory	44 (36-52)	56 (48-64)	9	4,757
CNB Penn Word Memory IR + DR	52 (41-62)	48 (38-59)	2	2,018
CVLT Trials 1-5 Sum	35 (26-45)	65 (55-74)	7	2,740
CVLT Semantic Clustering	39 (24-53)	61 (47-76)	2	533
CVLT Recognition	44 (35-53)	56 (47-65)	3	619
CVLT Long Delay Free Recall	55 (41-69)	45 (31-59)	2	355
WMS Logical Memory IR	62 (47-76)	38 (24-53)	2	201
Non-Verbal Memory	38 (32-44)	62 (56-68)	7	4,773
WMS Visual Reproduction IR	50 (16-84)	50 (16-84)	2	163
WMS Visual Reproduction DR	43 (21-65)	57 (35-79)	2	162
CNB Penn Face Memory IR + DR	36 (31-42)	64 (58-69)	3	2,948
CNB Penn Face Memory IR	38 (29-47)	62 (53-71)	2	2,139
CNB VOLT IR + DR	31 (28-34)	69 (66-72)	3	2,903
Verbal Ability	55 (44-66)	45 (34-56)	8	5,102
WRAT Reading	74 (68-80)	26 (20-32)	2	1,056
WAIS Vocabulary	74 (69-80)	26 (20-31)	3	1,955
WAIS Similarities	51 (20-81)	49 (19-80)	2	348
Semantic Fluency	48 (42-54)	52 (46-58)	2	449
Semantic + Phonemic Fluency	37 (20-54)	63 (46-80)	2	1,092
Phonemic Fluency	33 (21-45)	67 (55-79)	2	353
Visuospatial Ability	51 (46-55)	49 (45-54)	7	4,912
CNB JOLO Accuracy	54 (52-56)	46 (44-48)	3	2,862
WAIS Block Design	54 (39-68)	46 (32-61)	2	314
WAIS Matrix Reasoning	45 (33-56)	55 (44-67)	3	1,813
Executive Function	21 (14-28)	79 (72-86)	8	7,982
CNB PCET Accuracy	30 (19-40)	70 (60-81)	3	2,903
WCST Perseverative Errors	22 (19-26)	78 (74-81)	3	2,502
WCST Categories Completed	15 (15-15)	85 (85-85)	2	2,381
Motor Skills	39 (37-40)	61 (60-63)	4	1,443
CNB Mouse Practice Task RT	42 (33-51)	58 (49-67)	2	1,280
Purdue Pegboard Time Left + Right	37 (34-40)	63 (60-66)	2	170
Social Cognition	25 (17-32)	75 (68-83)	3	2,879
CNB Emotion Recognition Accuracy	23 (16-30)	77 (70-84)	2	2,502

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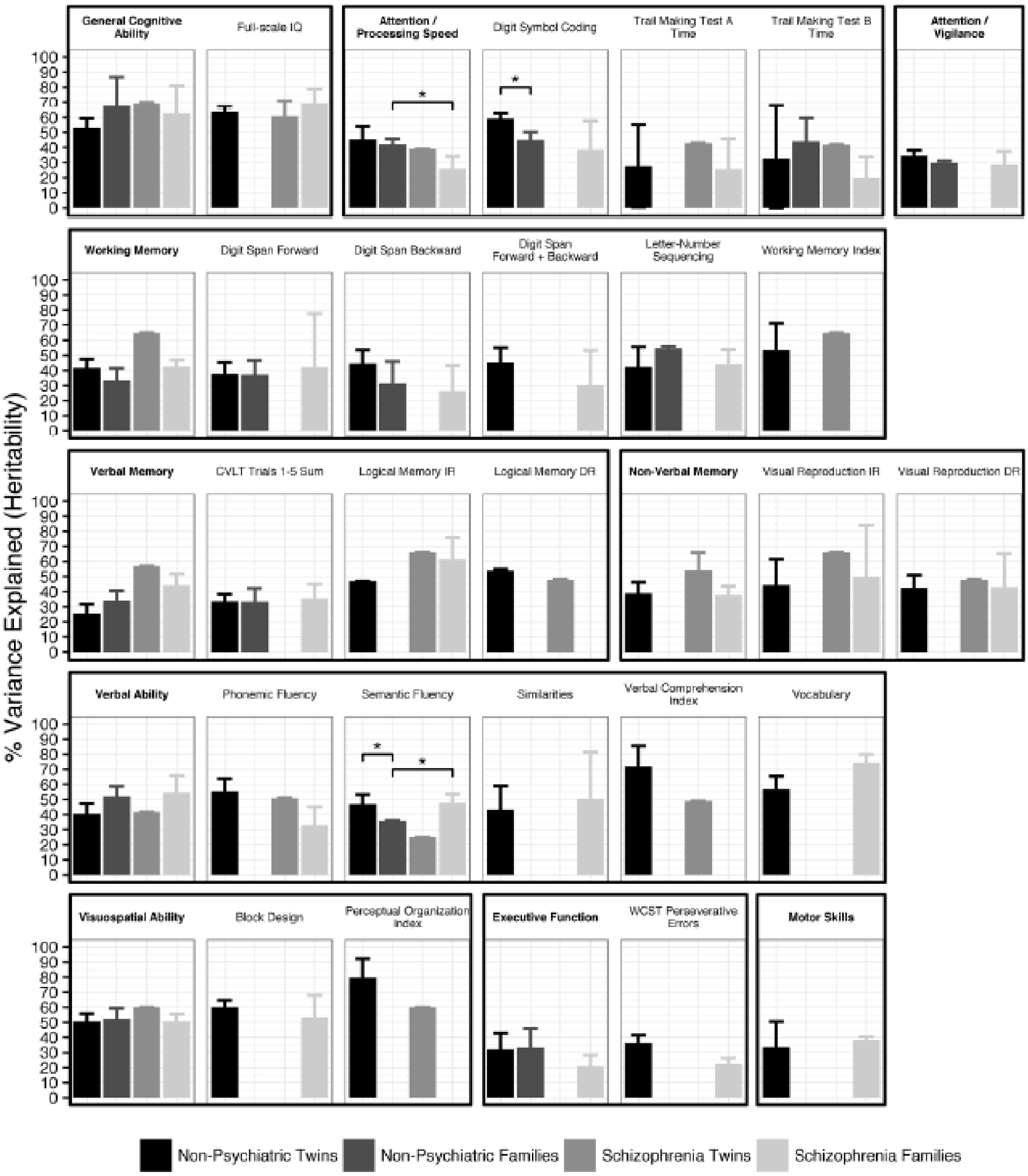

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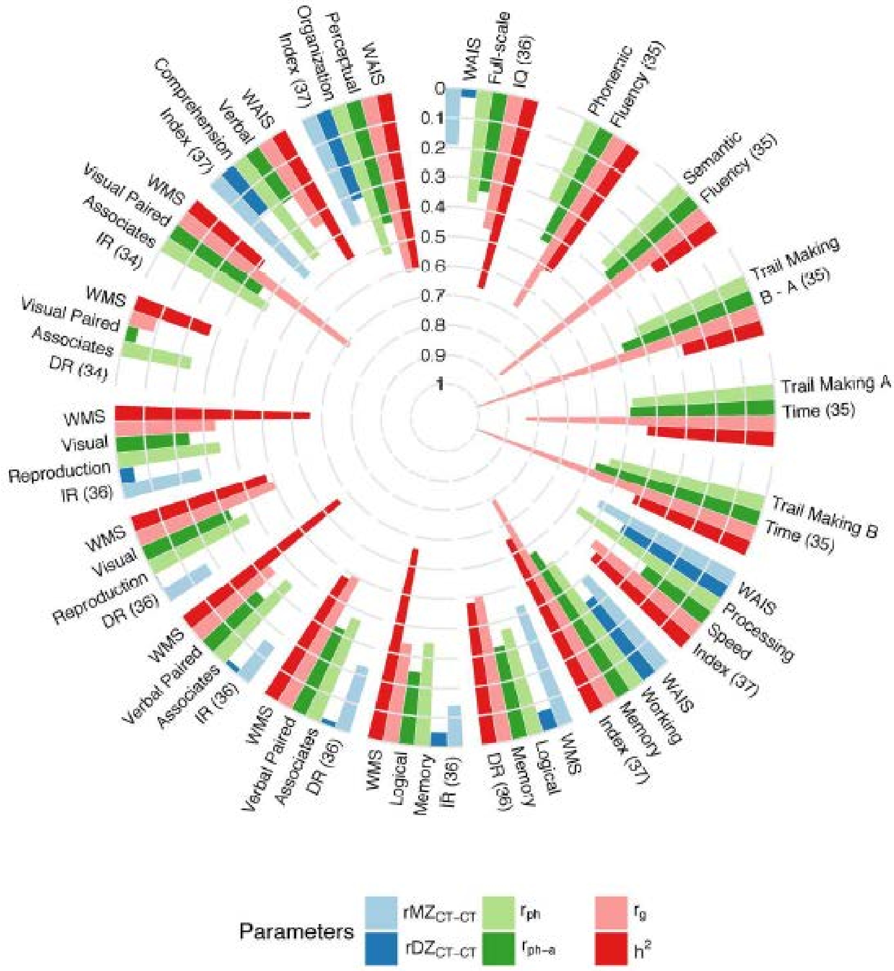

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Supplementary Materials for Blokland et al., Heritability of neuropsychological measures in schizophrenia and non-psychiatric populations: A systematic review and meta-analysis

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Supplementary Methods

Data collection

A literature search was performed in PubMed and PsycINFO using combinations of the following search terms: [heritability, genetic influences, behavior genetics, twin research, family, pedigree, individual differences, neuropsychological test, cognition, cognitive ability, endophenotype]. Additionally, we searched specifically for schizophrenia studies using combinations of the following search terms: [schizophrenia, genetic overlap, genetic correlation, cognition, endophenotype]. A flow diagram of the literature search, inclusion, and exclusion is shown in Supplementary Figure 1. The search resulted in a list of >2000 papers published prior to January 2016. Based on abstract review, 269 articles were retrieved and evaluated for their suitability for inclusion. An additional 93 articles were identified from the reference lists of the retrieved articles. We identified 296 studies of non-psychiatric twins or families, and 32 studies of schizophrenia twins or families, as well as 35 studies reporting estimates for other psychiatric and neurological disorders only that are not included in our analyses (Supplementary Table 2), from a total of 126 independent twin and family cohorts, listed in Supplementary Table 1. Thirtyseven non-psychiatric twin studies were excluded for various reasons outlined in Supplementary Table 3, including statistical model and phenotype. Furthermore, studies that reported variance component estimates (including heritability) based on MZ and DZ twin intra-pair correlations (30) or familial correlations (4) were excluded, since these estimates often do not sum to one and would therefore affect the accuracy of heritability meta-estimates (Falconer et al. 1996). Finally, based on the observation that, during development, heritability increases linearly with age (Haworth et al. 2010), 86 studies of non-psychiatric twins younger than 16 years were excluded from the meta-analyses (Supplementary Table 4). Non-psychiatric studies usually excluded individuals with a current psychiatric or neurological disorder, but did not necessarily screen for lifetime DSM-IV diagnosis, family history of psychiatric illness, or medical conditions that could impact cognition.

After these exclusions, 168 empirical articles describing twin or family studies were included in the analyses. These studies investigated the heritability of >600 neuropsychological test variables (outcome measures) in 64 independent twin and family cohorts. Among these 168 studies, there were 129 twin studies (Supplementary Table 5) and 13 family studies (Supplementary Table 6; 1 study was part of a publication also reporting on a schizophrenia family study) of non-psychiatric individuals, and 20 schizophrenia family studies (14 independent) (Supplementary Table 7). Additionally, there were 7 studies of twins/siblings concordant or discordant for schizophrenia (Supplementary Table 8); however, these were not meta-analyzed as there were no common neuropsychological measures across the two independent samples, thereby the requirement for meta-analysis was not met. Of the 129 nonpsychiatric twin studies, there were 30 late adolescent (16–17 years), 39 young adult (18–40 years), 25 middle age (41–65 years), and 35 older (>65 years) studies.

We performed separate meta-analyses of non-psychiatric twins, non-psychiatric families, and schizophrenia families. We meta-analyzed neuropsychological test variables that were reported in at least two independent cohorts. Additionally, neuropsychological test variables were assigned to one of the following 11 domains based on prior meta-analyses of cognition in schizophrenia (Heinrichs et al. 1998, Mesholam-Gately et al. 2009): General Cognitive Ability, Attention/Processing Speed, Attention/Vigilance, Working Memory, Verbal Learning and Memory, Non-Verbal Learning and Memory, Executive Function, Verbal Ability, Visuospatial Ability, Motor Skills, and Social Cognition. Meta-analyses of cognitive domains utilized all tests within a cognitive domain regardless of how many studies analyzed a particular test variable. If multiple tests within a cognitive domain were available for a given cohort, we included the average estimates for additive genetic effects (A), common environment (C), as well as unique environment and measurement error (E) across the tests in the domain meta-analysis.

Therefore, the sample size for a given cognitive domain differs from the summed sample size for test variables within that domain, because the inclusion criteria differed. Supplementary Table 9 describes the tests included in this meta-analysis, the cognitive functions they assess, and the cognitive domains they index.

Computation of A/C/E meta-estimates

The classical twin study design allows the decomposition of phenotypic variance into that due to additive genetic effects (A), common (shared) environment (C), and unique (unshared) environment and measurement error (E) (ACE model) (Blokland et al. 2013). In an alternative twin model, the phenotypic variance is divided into additive genetic (A), dominance genetic (D) and unique environmental (E) influences (ADE model). Because an ACE model was fitted in over 95% of the studies, for consistency we selected the variance component estimates from an ACE model over variance components from an ADE model if both models were reported. Variance component estimates from the full ACE model were selected over estimates from more parsimonious nested models (AE, CE, E). Family study (or extended pedigree) designs that do not include twins cannot distinguish the influences of A and C and therefore only provide an estimate of familiality (A+C), as well as E. Three of 13 family studies included a small proportion of twins (<1% of cohort) and therefore reported C. However, given the small number of twins, we summed A and C for those studies. In addition to decomposing the variance in one phenotype, twin and family studies can also decompose the co-variance between multiple phenotypes into A, C, and, E, thereby providing estimates of genetic overlap.

For each neuropsychological test or cognitive domain, the proportion of total variance accounted for by A, C, and E was calculated by averaging each component across studies from independent cohorts while weighting by sample size. For twin studies, the sample size equalled the total number of individuals from complete twin pairs plus any additional non-twin siblings multiplied by two (as each additional non-twin sibling provides two additional data points). For family studies, the sample size equaled the total number of individuals within each family. Due to insufficient available data, we were not able to meta-analyze heritability estimates separately for males and females. Therefore, if parameters were reported for males and females separately, the average was included in our meta-analyses. For studies that reported on the same neuropsychological test variable utilizing the same cohort, we only included data from the largest sample in our meta-analyses. For studies that estimated heritability for the same individuals at multiple time points, the heritability estimate for the time point with the largest sample size was included in the meta-analyses. Composite phenotypes (e.g. average Z-score across multiple tests) and principal component phenotypes were excluded, with the exception of general cognitive ability (first unrotated principal component), and a combined semantic + phonemic verbal fluency phenotype. All analyses were carried out in R (http://www.r-project.org) using custom scripts.

Comparison of heritability estimates between study designs
For cognitive phenotypes meta-analyzed in more than one study design, we assessed whether meta-heritability estimates were significantly different using a Wald test (Engle 1983). We specifically compared non-psychiatric twins and non-psychiatric families, as well as nonpsychiatric families with schizophrenia families. As some schizophrenia twin studies did not provide data to calculate standard errors of heritability estimates, Wald tests could not be performed for this design. P-values were Bonferroni-corrected for testing 15 cognitive phenotypes that were available for at least two study designs (0.05/15=0.0033).

Supplementary Table 1 – Cohort Index

ANT	Antioquia, Colombia	MPSS	Multidimensional Psychopathology Study of Schizophrenia, Taiwan *
ATR	Australian Twin Registry *	MTFS	Minnesota Twin Family Study *
B-SNIP	Bipolar-Schizophrenia Network on Intermediate Phenotypes *	MTR	Missouri Twin Registry *
CAP	Colorado Adoption Project	MTS	Maudsley Twin Study * / **
CAMH	Centre for Addiction and Mental Health	MTSADA	Minnesota Twin Study of Adult Development & Aging *
CCNMD	Center for the Neuroscience of Mental Disorders *	N2CAP	Northeast-Northwest Collaborative Adoption Projects
CFAM	Colorado Adolescent Substance Abuse Family Study	NAF	Norwegian Armed Forces *
CLDRC	Colorado Learning Disabilities Research Center *	NAMI	National Alliance for the Mentally Ill *
CLFADS	Caribbean Latino Familial Alzheimer's Disease Study	NASTR	National Academy of Sciences Twin Registry *
CLTS	Colorado Longitudinal Twin Study *	NCCP	National Collaborative Perinatal Project
CMHHC	Centers of Mental Health of Havana City *	NCN	North Carolina Neuropsychiatry
CNLSY	National Longitudinal Survey of Youth 1979 Children's	NHLBI	National Heart, Lung, and Blood Institute *
COGS	Consortium on the Genetics of Schizophrenia *	NIHSS	National Institutes of Health Sibling Study **
CRP	Colorado Reading Project	NLSAH	National Longitudinal Study of Adolescent Health *
CTS	Colorado Twin Study *	NLSY	National Longitudinal Survey of Youth 1979 *
CVCR	Central Valley of Costa Rica *	NMTS	National Merit Twin Study
DHS	Diabetes Heart Study	NPHIF	National Public Health Institute of Finland **
ECLS–B	Early Childhood Longitudinal Study, Birth Cohort	NTR	Netherlands Twin Registry *
EFPTS	East Flanders Prospective Twin Study *	OATS	Older Australian Twin Study *
EMPE	El-Minia Province, Egypt	OOA	Old Older Amish *
ERF	Erasmus Rucphen Family Study *	OSC	Ontario Science Centre
E-RISK	E-Risk Longitudinal Twin Study	OTSN	Oslo Twin Sample Norway *
FinnTwin12	Finnish population-based twin registry – Cohort 12 *	PAARTNERS	Project Among African-Americans to Explore Risks for Schizophrenia *
FinnTwin16	Finnish population-based twin registry – Cohort 16	PMFS	Pennsylvania Multigenerational Family Study *
FRI	Fels Research Institute	PUC	Peking University, China *
FSTR	Florida State Twin Registry *	PUMG	Philipps University of Marburg, Germany
FTPRBE	Florida Twin Project on Reading, Behavior, and Environment	QNTS	Quebec Newborn Twin Study
GMTR	Greater Manchester Twin Register	QTR	Qingdao Twin Registry *
GNUA	Group of Neurosciences, University of Antioquia, Colombia	RSTR	Russian School Twin Registry *
GOBS	Genetics of Brain Structure and Function *	SATSA	Swedish Adoption/Twin Study of Aging *
GOSAT	German Observational Study of Adult Twins *	SEFOS	Study on Etiological Factors of Schizophrenia, Taiwan *
GTR	Georgia Twin Registry	SFAHS	San Francisco Area High Schools
HATS	Non-Psychiatric Aging Twin Study *	SFHS	Scottish Family Health Study *
HFSC	Hawaii Family Study of Cognition	SMS1932-47	Scottish Mental Surveys of 1932 and 1947
HNFS	Harvard Neuropsychology Family Study **	STCLUHS	Scientific Twin Centre, Lithuanian University of Health Sciences
HSI	Haryana State, India	STR	Swedish Twin Registry *
HUJI	Hebrew University, Jerusalem, Israel	SUCC	Sichuan University, Chengdu, China *
IMAGE	International Multisite ADHD Genetics project	SYMTS	Swedish Young Male Twins Study **
INSERM	INSERM, France *	TCHS	Taipei City high schools, Taiwan

INSPE	Institute of Experimental Neurology, Italy *	TEDS	Twins Early Development Study *
IOP	Institute of Psychiatry, King's College London, UK	TSLS	Taiwan Schizophrenia Linkage Study *
ITR	Italian Twin Registry *	TwinsUK	St Thomas' Adult UK Twin Registry *
JUH	Jena University Hospital, Germany **	UBVS	Utah Bureau of Vital Statistics
KINDAI	Kinki University School of Medicine, Osaka, Japan	UCLA	University of California, Los Angeles *
KMTP-IUTP	Kinship of Monozygotic Parents & Indiana University Twin Panel *	UHK	University of Hong Kong
KTP	Keio Twin Project *	UK-DCSF	UK Department for Children, Schools and Families
LAS	London Area Schools	UK-MGSG	UK Mid Glamorgan & South Glamorgan counties
LLFS	Long Life Family Study *	UMCU	University Medical Center Utrecht, Netherlands * / **
LOADFS	Late Onset Alzheimer's Disease Family Study	UMMS	University of Milan Medical School, Italy
LSADT	Longitudinal Study of Aging Danish Twins *	UMN	University of Minnesota
LTS	Louisville Twin Study	UOB	University of Barcelona, Spain * / **
MADT	Middle Age Danish Twin study	UOCIL	University of Chicago, Illinois
MALTS	MacArthur Longitudinal Twin Study	UOZC	University of Zagreb, Croatia *
MAPS	Memory, Attention, and Problem Solving *	UPTS	University of Pittsburgh Twin Study *
MBF	Multiple Births Foundation	UUT	University of Utah
MBRNS	Medical Birth Registries of Norway and Sweden	UWO	University of Western Ontario *
MCM	Mexico City, Mexico *	VETR	Vietnam Era Twin Registry *
MCTFR	Minnesota Center for Twin and Family Research *	VETSA	Vietnam Era Twin Study of Aging *
MFS	Maudsley Family Study **	WOTP	Western Ontario Twin Project
MGH	Massachusetts General Hospital	WRAP	Wisconsin Registry for Alzheimer's Prevention
MHRC	Mental Health Research Centre, Moscow *	WRRP	Western Reserve Reading Project *
MISTRA	Minnesota Study of Twins Reared Apart *	WRTP	Western Reserve Twin Project
MOAFTS	Missouri Adolescent Female Twin Study *	WTCHG	Welcome Trust Centre for Human Genetics

* Cohorts included in the meta-analyses. ** Schizophrenia twin-family cohorts.

Supplementary Table 2 – Twin and Family Studies of Other Disorders Excluded from Meta-Analyses

	Reference	Twin Cohort(s) [a]	Disorder
1	Kieseppä et al. (2005)	NPHIF	Bipolar Disorder
2	Betjemann et al. (2010)	CLDRC	Reading Disability
3	Davis et al. (2001)	CRP / CLDRC	Reading Disability
4	Gayán et al. (2001)	CLDRC	Reading Disability
5	Knopik et al. (1997)	CLDRC	Reading Disability
6	Knopik et al. (1998a)	CLDRC	Reading Disability
	Knopik et al. (1998b)	CLDRC	Reading Disability (Healthy individuals included in Suppl Table 4)
	Knopik et al. (1999)	CLDRC	Reading Disability (Healthy individuals included in Suppl Table 4)
7	Knopik et al. (2002)	CLDRC	Reading Disability
8	LaBuda et al. (1987)	CRP	Reading Disability
	Light et al. (1998)	CLDRC	Reading Disability (Healthy individuals included in Suppl Table 4)
	Wadsworth et al. (1995)	CRP	Reading Disability (Healthy individuals included in Suppl Table 4)
9	Willcutt et al. (2007)	CLDRC	Reading Disability + Attention Deficit/Hyperactivity Disorder
10	Willcutt et al. (2010)	CLDRC	Reading Disability + Attention Deficit/Hyperactivity Disorder
11	Kremen et al. (2007c)	VETSA	Posttraumatic Stress Disorder
12	Latvala et al. (2011)	FinnTwin16	Alcohol Dependence
13	Kovas et al. (2005)	TEDS	Learning Disability
14	Kanakam et al. (2013)	IOP	Eating Disorder

	Reference	Family Cohort(s) [a]	Disorder
15	Antila et al. (2007)	NPHIF	Bipolar Disorder
16	Antila et al. (2009)	NPHIF	Bipolar Disorder
17	Fears et al. (2014)	ANT / CVCR	Bipolar Disorder
18	Glahn et al. (2010)	GOBS / CVCR / MCM	Bipolar Disorder
	Hill et al. (2013)	B-SNIP	Bipolar Disorder (Schizophrenia individuals included in Suppl Table 7)
19	Darst et al. (2015)	WRAP	Alzheimer's Disease
20	Johnson et al. (2007a)	CLFADS	Alzheimer's Disease (unaffected only)
21	Lee et al. (2004)	CLFADS	Alzheimer's Disease
22	Wilson et al. (2011)	LOADFS	Alzheimer's Disease
23	Andreou et al. (2007)	IMAGE	Attention Deficit/Hyperactivity Disorder
24	Cheung et al. (2012)	IMAGE	Attention Deficit/Hyperactivity Disorder + Reading Disability
25	Crosbie et al. (2013)	OSC	Attention Deficit/Hyperactivity Disorder
26	Doyle et al. (2008)	MGH	Attention Deficit/Hyperactivity Disorder
27	Frazier-Wood et al. (2012)	IMAGE	Attention Deficit/Hyperactivity Disorder
28	Kuntsi et al. (2010)	IMAGE	Attention Deficit/Hyperactivity Disorder
29	Peskin et al. (2015)	CVCR	Attention Deficit/Hyperactivity Disorder
30	Pineda et al. (2011)	GNUA	Attention Deficit/Hyperactivity Disorder
31	Rommelse et al. (2008)	IMAGE	Attention Deficit/Hyperactivity Disorder
32	Wood et al. (2011)	IMAGE	Attention Deficit/Hyperactivity Disorder
33	Cox et al. (2014)	DHS	Diabetes Mellitus
34	Marlow et al. (2001)	WTCHG	Reading Disability
35	Francks et al. (2003)	WTCHG	Reading Disability

[a] For cohort name abbreviations see Supplementary Table 1.

Supplementary Table 3 – Non-Psychiatric and Schizophrenia Twin and Family Studies Excluded from Meta-Analyses

	Reference	Non-Psychiatric Twin Cohort(s)[a]	Reason
1	Chipuer et al. (1990)	MISTRA	Assortative Mating model
2	Kirkpatrick et al. (2015)	MTFS	Genes x Environment (GxE) Interaction model
3	Turkheimer et al. (2003)	NCCP	Genes x Environment (GxE) Interaction model
4	Finkel et al. (2000b)	SATSA	Inclusion of non-NP measure in factor phenotype.
5	Luo et al. (2003)	WRTP	A+C+E do not sum to one (i.e. A+C+E explained <100% or >100% of the phenotypic variance not due to rounding errors)
6	Myles-Worsley et al. (1997)	UBVS	A+C+E do not sum to one
7	Finkel et al. (1996)	SATSA	Graphical display of results only
8	Finkel et al. (1998b)	SATSA	Graphical display of results only
9	Finkel et al. (2006)	SATSA	Graphical display of results only
10	McGue et al. (2013)	MADT	Graphical display of results only
11	Bishop et al. (2008)	TEDS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
12	Haworth et al. (2009a)	TEDS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
13	Haworth et al. (2009b)	TEDS / WRRP / MTFS / CLTS / CTS / CLDRC / MAPS / NTR	Liability Threshold Model / DeFries-Fulker Extremes Analysis
14	Hayiou-Thomas et al. (2010)	TEDS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
15	Hayiou-Thomas et al. (2014)	TEDS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
16	Kirkpatrick et al. (2011)	MISTRA	Liability Threshold Model / DeFries-Fulker Extremes Analysis
17	Petrill et al. (1997)	MALTS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
18	Petrill et al. (2001)	STR	Liability Threshold Model / DeFries-Fulker Extremes Analysis
19	Price et al. (2004)	TEDS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
20	Reynolds et al. (2006)	STR	Liability Threshold Model / DeFries-Fulker Extremes Analysis
21	Saudino et al. (1994)	SATSA	Liability Threshold Model / DeFries-Fulker Extremes Analysis
22	Spinath et al. (2004)	TEDS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
23	Viding et al. (2003)	TEDS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
24	Viding et al. (2004)	TEDS	Liability Threshold Model / DeFries-Fulker Extremes Analysis
25	Asbury et al. (2005)	TEDS	Observational measure of infant development
26	DeThorne et al. (2005)	TEDS	Observational measure of infant development
27	Eley et al. (1999)	TEDS	Observational measure of infant development
28	Emde et al. (1992)	MALTS	Observational measure of infant development
29	Koeppen-Schomerus et al. (2000)	TEDS	Observational measure of infant development
30	Koeppen-Schomerus et al. (2003)	TEDS	Observational measure of infant development
31	McArdle (1986)	LTS	Observational measure of infant development
32	Plomin et al. (1993)	MALTS	Observational measure of infant development
33	Price et al. (2000)	TEDS	Observational measure of infant development
34	Scourfield et al. (1999)	UK-MGSG	Observational measure of infant development
35	Spinath et al. (2003)	TEDS	Observational measure of infant development
36	Tucker-Drob et al. (2011)	ECLS-B	Observational measure of infant development
37	Tucker-Drob et al. (2012)	ECLS-B	Observational measure of infant development
38	Austin et al. (1980)	IOP	No Structural Equation Modeling
39	Bouchard Jr. (1983)	MISTRA	No Structural Equation Modeling
40	Bouchard et al. (1990)	MISTRA	No Structural Equation Modeling
41	Byrne et al. (2010)	CTS / ATR	No Structural Equation Modeling

42	Campana et al. (1996)	UMMS	No Structural Equation Modeling
43	Detterman et al. (1990)	WRTP	No Structural Equation Modeling
44	Foch et al. (1980)	CTS	No Structural Equation Modeling
45	Friedman et al. (2006)	CLTS	No Structural Equation Modeling
46	Grigorenko et al. (1992)	RSTR	No Structural Equation Modeling
47	Hayakawa et al. (1992)	KINDAI	No Structural Equation Modeling
48	Holmes et al. (2002)	GMTR	No Structural Equation Modeling
49	Jensen et al. (1979)	SFAHS	No Structural Equation Modeling
50	Kalasūnienė et al. (2013)	STCLUHS	No Structural Equation Modeling
51	Kremen et al. (2007a)	VETR	No Structural Equation Modeling
52	Pal et al. (1997)	HSI	No Structural Equation Modeling
53	Pedersen et al. (1985)	STR	No Structural Equation Modeling
54	Petrill et al. (2004)	N2CAP	No Structural Equation Modeling
55	Plassman et al. (1995)	NASTR	No Structural Equation Modeling
56	Rodgers et al. (1987)	FRI	No Structural Equation Modeling
57	Rushton et al. (2007)	WOTP / MISTRA	No Structural Equation Modeling
58	Sabb et al. (2013)	UCLA	No Structural Equation Modeling
59	Sachdev et al. (2011)	OATS	No Structural Equation Modeling
60	Segal (1985)	UOCIL	No Structural Equation Modeling
61	Swan et al. (1992)	NHLBI	No Structural Equation Modeling
62	Vernon (1989)	WOTP	No Structural Equation Modeling
63	Wilmer et al. (2010)	ATR	No Structural Equation Modeling

	Reference	Non-Psychiatric Family Cohort(s)	Reason
64	Bennett et al. (1985)	HFSC	No Structural Equation Modeling
65	Guttman (1974)	HUJI	No Structural Equation Modeling
66	Hervey et al. (2012)	NCN	No Structural Equation Modeling
67	McGee (1978)	UMN	No Structural Equation Modeling
68	Nagoshi et al. (1987)	HFSC	No Structural Equation Modeling

	Reference	SCZ Twin/Family Cohort(s)	Reason
69	Cannon et al. (2000)	NPHIF	No Structural Equation Modeling
70	Goldberg et al. (2010)	MTS / UOB	No Structural Equation Modeling
71	Grove et al. (1991)	UMN	No Structural Equation Modeling
72	Kremen et al. (2006)	VETR	No Structural Equation Modeling
73	Pardo et al. (2000)	WUTR	No Structural Equation Modeling

[a]For cohort name abbreviations see Supplementary Table 1.

Supplementary Table 4 – Characteristics of Non-Psychiatric Twin Studies < 16 Years of Age Excluded from Meta-Analyses

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c]
PEDIATRIC (ages 0-12; 81 studies)				
Anokhin et al. (2010)	MTR	T1: 12.5±0.2 T2: 14	MZ: 166; DZ: 119	WCST
Arden et al. (2014)	TEDS	T1: 4 T2: 14	T1: MZ: ~3719; DZ: ~3719 T2: MZ: ~1174; DZ: ~1174	Spearman's 'g'
Bartels et al. (2002)	NTR	T1: 5.3 [5–5] T2: 6.8 [6–7] T3: 10 [10–10] T4: 12 [12–12]	T1: MZ: 89; DZ: 120 T2-4: MZ: 96; DZ: 96	FIQ
Benyamin et al. (2005)	SMS1932-47	11 [11–11]	MZ: 316; DZ: 773	Moray House Test
Bishop et al. (2003)	CLTS / CAP	T1: 1; T2: 2; T3: 3; T4: 4; T5: 7; T6: 9; T7: 10; T8: 12	MZ: 331; DZ: 267	MDI, SBIS, WISC: Spearman's 'g'
Brooks et al. (1990)	CRP	12.5 [7.6–20.5]	MZ: 86; DZ: 60	PIAT Reading Recognition, Reading Comprehension, Spelling; WISC/WAIS FIQ
Brouwer et al. (2014b)	NTR	T1: 9.1±0.1 T2: 12.1±0.3	T1: MZ: 38; DZ: 46 T2: MZ: 23; DZ: 28	WISC-III FIQ, VIQ, PIQ
Byrne et al. (2002)	CLTS / ATR / MBRNS	CLTS: 4.9 [3.9–5.7] ATR: 4.9 [4.5–5.9] MBRNS: 5.1 [4.8–5.6]	MZ: 125; DZ: 125	Word Blending; Syllable and Phoneme Blending; Sound Matching; Word Elision; Syllable and Phoneme Elision; Rhyme & Final Phoneme Match; Phoneme Identity Training; Visuospatial Learning; Story Memory; Auditory-Visual Paired-Associate Learning; HPNT; Nonword Repetition; RAN; Productive Morphology; Productive Grammar; Environmental Print; WRMT Word Recognition; Letter Name Recognition; Letter-Phoneme Recognition; Print Conventions; WPPSI-R Block Design, Vocabulary, Sentence Memory; Composites
Byrne et al. (2005)	CLTS / ATR	CLTS: 6.3 [6–6] ATR: 6.1 [6–6]	MZ: 172; DZ: 153	TROG Items; TOWRE Reading; Spelling; Phonological Awareness; Rapid Automatized Naming
Byrne et al. (2006)	CLTS / ATR / MBRNS	CLTS: 4.9 [3.9–5.7] ATR: 4.8 [4.5–5.9] MBRNS: 5.1 [4.8–5.6]	MZ: 312; DZ: 315	Phonological Awareness; Rapid Automatized Naming; Print Awareness; Composites
Byrne et al. (2008)	CLTS / ATR / MBRNS	MZ: 8.2±0.4; DZ: 8.3±0.4	MZ: 225; DZ: 214	Orthographic Learning; WRAT Spelling; Decoding Errors; WPPSI-R Block Design
Byrne et al. (2009)	CLTS / ATR / MBRNS	CLTS: 8.4±0.3 ATR: 7.9±0.3 MBRNS: 8.7±0.3	MZ: 303; DZ: 312	TOWRE Sight Word Efficiency, Phonemic Decoding Efficiency; WRMT-R Passage Comprehension; WRAT Spelling; BNT
Byrne et al. (2013)	CLTS / ATR / MBRNS	T1: CLTS: 4.9 [3.9–5.7] T1: ATR: 4.9 [4.5–5.9] T1: MBRNS: 5.3 [4.8–5.6] T2: CLTS: 8.4±0.3 T2: ATR: 7.9±0.3 T2: MBRNS: 8.7±0.3	T1: MZ: 520; DZ: 522 T2: MZ: 433; DZ: 437	WRAML Story Memory, Sound-symbol; Nonword Repetition; WPPSI Sentence Memory, Vocabulary; Hundred Pictures Naming Test; BNT; Letter Knowledge; Orthographic Learning; TOWRE Sight Word Efficiency, Phonemic Decoding Efficiency
Calvin et al. (2012)	UK-DCSF / PRIMA	UK-DCSF: 11.2±0.3 PRIMA: T1: 8; T2: 10; T3: 12	UK-DCSF: MZ: 1056; DZ: 495 PRIMA: MZ: 785; DZ: 327	CAT Verbal Reasoning, Nonverbal Reasoning, Quantitative Reasoning; Spearman's 'g'; Academic Measures; FIQ; Arithmetic, Language
Cherny et al. (1992)	MALTS / CAP	T1: 1; T2: 2; T3: 3	T3: MZ: 34; DZ: 28	SBIS FIQ
Cheung et al. (2014)	TEDS	8.8±0.7 [7–10]	MZ: 257; DZ: 387	WISC Digit Span Forward, Digit Span Backward; Go/No-Go + Choice RT SD
Chow et al. (2011)	UHK	6.7±? [3–11]	MZ: 228; DZ: 84	HKT-SLD Word Reading; PPVT; Phonological Memory; Tone Awareness, Syllable & Rhyme Awareness, Morphological Awareness, Orthographic Skills; RAN
Chow et al. (2013)	UHK	6.7±? [3–11]	MZ: 228; DZ: 84	RCPM; Composites of HKT-SLD Word Reading, PPVT, Phonological Memory, Tone Awareness, Syllable & Rhyme Awareness, RAN,

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c]
				Morphological Awareness, Orthographic Skills
Coventry et al. (2011)	CLTS / ATR / MBRNS	4.9±? [4–5]	MZ: 496; DZ: 489	Static Phonological Awareness, Dynamic Phonological Awareness, Letter Knowledge; TOWRE
Dale et al. (2010)	TEDS	12.0 [12–12]	MZ: 1758; DZ: 3134	WISC-III Vocabulary; TOAL Listening Grammar; TOLC Making Inferences, Figurative Language
Davis et al. (2008)	TEDS	10 [10–10]	MZ: 919; DZ: 1622	Mathematics; PIAT Reading Comprehension; Spearman's 'g'
Davis et al. (2009)	TEDS	T1: 2 T2: 3 T3: 4 T4: 7 T5: 9 T6: 10	T1: MZ: 1633; DZ: 3208 T2: MZ: 1379; DZ: 2685 T3: MZ: 2078; DZ: 4050 T4: MZ: 1616; DZ: 2889 T5: MZ: 1045; DZ: 1767 T6: MZ: 838; DZ: 1440	Phonological decoding; Orthographic Choice; PIAT; Spearman's 'g'
Davis et al. (2014)	TEDS	12.5 [12–12]	MZ: 1011; DZ: 1783	Composite of PIAT Reading Comprehension + GOAL Reading Comprehension + WRMT Reading Fluency + TOWRE Word Reading Efficiency; Composite of UK National Curriculum Tests
DeThorne et al. (2008)	WRRP	MZ: 7.1±0.7; DZ: 7.1±0.6 [6–8]	MZ: 78; DZ: 112	BNT; SBIS Vocabulary
Edmonds et al. (2008)	MBF	MZ/DZ: 11.5±2.1 [7.9–17.3]; SIB: 12.5±2.8 [7.5–16.5]	MZ: 67; DZ: 44; SIB: 19	Line Discrimination Task; WISC-III VIQ, PIQ, FIQ
Gayán et al. (2003)	CLDRC	10.6 [7.8–18.6]	MZ: 257; DZ: 183	WISC-R/WAIS-R FIQ; PIAT Phoneme Awareness; TWR Word Recognition, Phonological Decoding, Orthographic Coding composite
Greven et al. (2014)	TEDS	12 [12–12]	MZ: 2191; DZ: 3930	Spearman's 'g'; Composite; Mathematics
Groot et al. (2004)	NTR	5.8±0.1	MZ: 125; DZ: 112	Go/No Go; Sustained Attention Task
Harlaar et al. (2005)	TEDS	7.1±0.2 [7–7]	MZ: 2292; DZ: 4184	TOWRE; Composite
Harlaar et al. (2007)	TEDS	10 [10–10]	MZ: 1561; DZ: 2068	PIAT Reading Comprehension
Harlaar et al. (2010)	WRRP	9.9±0.9	MZ: 89; DZ: 131	WRMT Word Attack, Word Identification, Passage Comprehension; TOWRE Phonemic Decoding Efficiency, Sight Word Efficiency; CELF Understanding Spoken Paragraphs, Word Chains; TNL Narrative Comprehension; PIAT Reading Comprehension; BNT
Hart et al. (2007)	WRRP	T1: 6.0±0.7 [4.3–7.9] T2: 7.2±0.7 [6.0–8.8]	MZ: 123; DZ: 164	SBIS FIQ
Hart et al. (2009)	WRRP	T1: 6.1±0.7 [4.3–8.3] T2: 7.2±0.7 [6.0–8.8] T3: 8.3±0.7 [6.2–10.0]	MZ: 128; DZ: 175	BNT
Hart et al. (2013a)	FTPRBE	T1: 6–7 T2: 7–8 T3: 8–9 T4: 9–10 T5: 10–11	T1: MZ: 243; DZ: 455 T2: MZ: 224; DZ: 411 T3: MZ: 152; DZ: 297 T4: MZ: 54; DZ: 90 T5: MZ: 24; DZ: 43	DIBELS Oral Reading Fluency
Hart et al. (2013b)	FTPRBE	8.2±1.3 [8–9]	MZ: 189; DZ: 388	FCAT Reading Comprehension
Hayiou-Thomas et al. (2006a)	TEDS	4.5±0.2 [4–4]	MZ: 221; DZ: 226	Bus Story; Renfrew Action Picture Test Grammar Score; BAS Verbal Comprehension; Word Knowledge; Semantic Fluency; Verbal Memory; Phonological Awareness; GF Articulation; Non-word Repetition; Composite
Hayiou-Thomas et al. (2006b)	TEDS	4.5±0.2 [4–4]	MZ: 281; DZ: 275	Bus Story; Renfrew Action Picture Test Grammar Score; BAS Verbal Comprehension; Word Knowledge; Semantic Fluency; Verbal Memory; Phonological Awareness; GF Articulation; Non-word Repetition
Hayiou-Thomas et al. (2012)	TEDS	T1: 2; T2: 3; T3: 4; T4: 7; T5: 9; T6: 10; T7: 12	MZ: 3959; DZ: 3927	WISC-III Vocabulary; TOLC Figurative Language, Making Inferences; TOAL Listening Grammar
Heiser et al. (2006)	PUMG	9.0±2.0 [6–11]	MZ: 17; DZ: 12	Go/No Go
Ho et al. (1988)	CRP / CLDRC	MZ: 12.9±2.7; DZ: 13.1±2.5 [8.5–18]	MZ: 30; DZ: 30	FIQ; RAN; Colorado Perceptual Speed

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c]
Ho et al. (2012)	UHK	7.8±1.6 [5–11.5]	MZ: 190; DZ: 80	PPVT; HKT-SLD Word Reading, Sentence Comprehension, Passage Comprehension; RCPM
Hohnen et al. (1999)	LAS	T1: 5.8 [5.7–6.1] T2: 7.0 [6.8–7.3]	T1: MZ: 89; DZ: 120 T2: MZ: 89; DZ: 120	PIQ; Composites
Jacobs et al. (2001)	EFPTS	[8–14]	MZ: 270; DZ: 181	WISC-R Vocabulary, Information, Similarities, Comprehension, Arithmetic, Picture Completion, Picture Arrangement, Object Assembly, Block Design, Digit Symbol Coding, Digit Span, VIQ, PIQ, FIQ
Jacobs et al. (2002)	EFPTS	11.1±1.5 [8–14]	MZ: 286; DZ: 377	FIQ
Kirkpatrick et al. (2009)	MTFS	C1: 11.8±0.4 [10–13] C2: 17.5±0.5 [16–18]	MZ: 2392; DZ: 1372	FIQ
Knopik et al. (1998b)	CLDRC	11.8 [8–20]	MZ: 206; DZ: 208	PIAT discriminant function score (DISCR) Reading Recognition, Reading Comprehension, Spelling
Knopik et al. (1999)	CLDRC	11.7 [8–20]	MZ: 220; DZ: 135	PIAT Reading Recognition, Reading Comprehension, Spelling, Mathematics; WISC/WAIS Arithmetic; WRAT Arithmetic; latent factors
Koenen et al. (2006)	E-RISK	5 [5–5]	MZ: 603; DZ: 513	FIQ
Kuntsi et al. (2006)	TEDS	8.4±0.3 [7–9]	MZ: 156; DZ: 244	Go/No Go; Fast Task; MICDA; WISC Digit Span
Light et al. (1998)	CLDRC	12.1 [8–20]	MZ: 132; DZ: 91	PIAT Reading Recognition, Reading Comprehension, Spelling, Mathematics; WISC/WAIS Arithmetic; Phonological Decoding
Logan et al. (2013)	WRRP	T1: 6.1; T2: 7.2; T3: 8.2; T4: 9.8; T5: 10.9; T6: 12.1	MZ: 371; DZ: 213	WRMT Word Identification, Word Attack, Reading Comprehension; RAN
Luo et al. (1994)	WRTP	[6–12]	MZ: 148; DZ: 135	CAP Verbal Fluency; PMA Spatial Relations; Colorado Perceptual Speed; ETS Hidden Patterns; CAP Names & Faces; HFSC Picture Memory; WISC Vocabulary, Information, Similarities, Comprehension, Arithmetic, Picture Completion, Picture Arrangement, Object Assembly, Block Design, Digit Symbol Coding, Digit Span
Mosing et al. (2012)	MAPS	12 [12–12]	MZ: 57; DZ: 112	VESPARCH1
Olson et al. (2007)	CLTS / ATR / MBRNS	T1: CLTS: 4.10±2.3 T1: ATR: 4.9±3.4 T1: MBRNS: 5.0±1.7 T2: CLTS: 8.5±3.8 T2: ATR: 7.11±4.5 T2: MBRNS: 8.9±3.7 T3: CLTS: 10.5±3.9	T1: MZ: 497; DZ: 500 T2: MZ: 406; DZ: 424 T3: MZ: 176; DZ: 213	BNT; TOWRE Word Recognition, Decoding; WRMT Passage Comprehension; Composites
Peterson et al. (2013)	CLTS / ATR / MBRNS	T1: 5; T2: 7; T3: 8	MZ: 520; DZ: 525	CNRT; WPPSI Sentence Memory, Vocabulary; BNT
Petrill et al. (1993)	WRTP	9.5±1.8 [6–13]	MZ: 89; DZ: 74	Spearman's 'g'
Petrill et al. (1995)	WRTP	9.6±1.8 [6–13]	MZ: 149; DZ: 138	CAT Learning, Self-Paced Probe Recall, Stimulus Discrimination, Probe Recall, Tachistoscopic Threshold
Petrill et al. (1996)	WRTP	9.6±1.8 [6–13]	MZ: 135; DZ: 128	WISC Information, Similarities, Arithmetic, Vocabulary, Comprehension, Picture Completion, Picture Arrangement, Block Design, Object Assembly, Digit Symbol, Digit Span, CAT Learning, Self-Paced Probe Recall, Stimulus Discrimination, Probe Recall, Tachistoscopic Threshold
Petrill et al. (1998)	MALTS	3 [3–3]	MZ: 156; DZ: 145	SBIS FIQ
Petrill et al. (2006a)	WRRP	MZ: 6.1±0.8 [5.0–7.9]; DZ: 6.1±0.7 [4.9–7.7]	MZ: 118; DZ: 163	Phonological Awareness; RAN; WRMT Reading
Petrill et al. (2006b)	WRRP	MZ: 6.1±0.7 [5.0–7.9]; DZ: 6.1±0.7 [4.3–7.7]	MZ: 102; DZ: 140	Spearman's 'g'; WRMT Letter Identification; Word Identification; Word Attack; Phonological Awareness; RAN
Polderman et al. (2006a)	NTR	T1: 5.8±0.1 [5.7–5.9] T2: 12.4±0.2 [12–12]	T1: MZ: 125; DZ: 112 T2: MZ: 97; DZ: 80	RAKIT/WISC FIQ; ANT Selective Attention, Memory Search, Sustained Attention
Polderman et al. (2006b)	NTR	MZ/DZ: 12.4±0.2 [12]; SIB: [8–15]	MZ: 97; DZ: 80; SIB: 55	ANT Memory Search; WISC Arithmetic, Digit Span, FIQ

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c]
Rietveld et al. (2003)	NTR	T1: 5.3 [5–5] T2: 6.8 [6–7] T3: 10.0 [10–10]	T1: MZ: 89; DZ: 120 T2: MZ: 79; DZ: 113 T3: MZ: 82; DZ: 115	RAKIT Exclusion, Discs, Hidden Figures, Verbal Meaning, Learning Names, Idea Production
Samuelsson et al. (2005)	CLTS / ATR / MBRNS	CLTS: 4.9±0.2 [3.9–5.7] ATR: 4.9±0.3 [4.5–5.9] MBRNS: 5.1±0.2 [4.8–5.6]	MZ: 312; DZ: 315	RAN; Phonological Awareness; Composites
Samuelsson et al. (2008)	CLTS / ATR / MBRNS	T1: CLTS: 6.3±0.3 T1: ATR: 6.0±0.4 T1: MBRNS: 6.7±0.3 T2: CLTS: 7.4±0.3 T2: ATR: 7.0±0.4 T2: MBRNS: 7.7±0.3	T1-2: MZ: 402; DZ: 410 T3: MZ: 341; DZ: 348	TOWRE Reading, BFB Spelling, WRAT Spelling
Schachar et al. (2011)	QNTS	8.4±0.1	MZ: 55; DZ: 76	Stop Task (Go / No Go + SST)
Soden-Hensler et al. (2012)	FTPRBE	5.6±0.4 [5–5]	MZ: 427; DZ: 825	Letter Naming Fluency; Phoneme Segmentation Fluency; Nonsense Word Fluency
Stins et al. (2004)	NTR	12 [12–12]	MZ: 75; DZ: 64	SCWT; Eriksen Flanker Task
Stins et al. (2005)	NTR	5.8±0.1 [5.7–5.9]	MZ: 125; DZ: 112	ANT Selective Attention, Memory Search
Taylor et al. (2010)	FTPRBE	T1: 5.5±0.3 T2: 6.6±0.4	MZ: 1834; DZ: 3542	Letter Naming Fluency; Phoneme Segmentation Fluency; Nonsense Word Fluency
Thapar et al. (1994)	WRTP	9.5±1.8 [6–13]	MZ: 137; DZ: 127	CAT Learning, Probe Recall, Self-Paced Probe Recall; SCA Picture Memory; Names & Faces; WISC Digit Span
Thompson et al. (1991)	WRTP	9.8 [6–12]	MZ: 92; DZ: 41	Composites; MAT Reading, Mathematics, Language
Thompson et al. (1993)	WRTP	9.6±1.8 [5–13]	MZ: 148; DZ: 135	Composite; FIQ; Achievement
Tosto et al. (2014a)	TEDS	11.6±0.7 [11–12]	MZ: 1539; DZ: 2635	Composite of NFER Jigsaws + Hidden Shapes; UK National Curriculum Tests Mathematics
van Leeuwen et al. (2008)	NTR	MZ/DZ: 9.1±0.1 [9–9]; SIB: 11.8±1.2 [9–14]	MZ: 48; DZ: 64; SIB: 100	RSPM
van Leeuwen et al. (2009a)	NTR	MZ/DZ: 9.1±0.1 [9–9]; SIB: 11.8±1.2 [9–14]	MZ: 48; DZ: 64; SIB: 100	RSPM; WISC Verbal Comprehension Index, Perceptual Organization Index, Processing Speed Index
van Leeuwen et al. (2009c)	NTR	MZ/DZ: 9.1±0.1 [9–9]; SIB: 11.8±1.2 [9–14]	MZ: 48; DZ: 64; SIB: 100	WISC FIQ, Digit Span; Corsi Block Tapping; n-back; OMRT Reading
van Soelen et al. (2009)	NTR	MZ/DZ: 9.1±0.1 [9–9]; SIB: 11.8±1.2 [9–14]	MZ: 48; DZ: 64; SIB: 100	RAVLT
van Soelen et al. (2011)	NTR	T1: MZ/DZ: 9.1±0.1 [9–11]; SIB: 10.9±10.4 [9–11] T2: MZ/DZ: 12.1±0.3 [12–14]; SIB: 12.8±0.9 [12–14]	T1: MZ: 48; DZ: 64; SIB: 46 T2: MZ: 40; DZ: 49; SIB: 69	WISC VIQ, PIQ, FIQ
ADOLESCENCE (ages 13-16; 5 studies)				
Abdel-Rahim et al. (1990)	EMPE	14.7 [12—19]	MZ: 36; DZ: 57	ETS/DAT composites; Spearman's '*g*'
Chou et al. (2010)	TCHS	13.7±0.9 [12–16]	MZ: 257; DZ: 140	WCST
Molenaar et al. (2012)	GTR	15.3±1.6 [12–20]	MZ: 247; DZ: 230	Mazes; Object Aperture test; Arithmetic; Newcastle Spatial test; Spearman's '*g*'
Wadsworth et al. (1995)	CRP	11 [8–20]	MZ: 109; DZ: 74	PIAT Reading Recognition, Reading Comprehension, Spelling; DTLA Auditory Attention Span; WISC-R/WAIS-R Digit Span; Composites
Waldman (2005)	GTR	13.2±2.5 [6–18]	MZ: 51; DZ: 34	TMT-A; TMT-B

[a]For cohort name abbreviations see Supplementary Table 1.
[b]For test name abbreviations see Supplementary Table 9.
[c]Semicolons separate instruments, commas separate subtest of same instrument.
Abbreviations: MZ = Monozygotic (n pairs); DZ = Dizygotic (n pairs); SIB = Siblings; PC = Principal Component; T = Time; C = Cohort.

Supplementary Table 5 – Characteristics of Non-Psychiatric Twin Studies > 16 Years of Age

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c,d]
LATE ADOLESCENCE (ages 16-17; 30 studies)				
Beaver et al. (2013)	NLSAH	NLSAH: T1: 16.1±1.7 [12–21]; T2: [18–26]	MZ: 278; DZ: 437; SIB: 2744	PPVT*
Bratko (1996)	UOZC	MZ: 17.0±1.3; DZ: 17.4±1.4 [15–19]	MZ: 71; DZ: 78	ETS Surface Development, Card Rotations; Phonemic Fluency; MFBT Vocabulary
Bratko et al. (2010)	UOZC	MZ: 17.0±1.3; DZ: 17.4±1.4 [15–19]	MZ: 71; DZ: 78	ETS Surface Development*, Card Rotations*; Phonemic Fluency*; MFBT Vocabulary*
Friedman et al. (2008)	CLTS	T1: 16.6±0.8 [15.8–20.0] T2: 17.3±0.6 [16.1–20.1]	MZ: 316; DZ: 266	Spearman's '*g*'*, WAIS-III FIQ, Vocabulary*, Similarities*, Information*, Comprehension*, Arithmetic*, Digit Span*, Picture Completion*, Block Design*, Picture Arrangement*, Object Assembly*, Digit Symbol Coding*, Verbal Comprehension Index*, Working Memory Index*, Processing Speed Index, Perceptual Organization Index*; Go / No Go*; SCWT*; n-back*; ETS Hidden Patterns*, Identical Pictures*; Colorado Perceptual Speed*
Friedman et al. (2011)	CLTS	T1: 16.6±0.8 [15.8–20.0] T2: 17.3±0.6 [15.8–20.1]	MZ: 217; DZ: 189	WAIS-III FIQ, Vocabulary, Similarities, Comprehension, Arithmetic, Digit Span, Picture Completion, Block Design, Picture Arrangement, Object Assembly, Digit Symbol Coding; Go / No Go; SCWT; n-back; ETS Hidden Patterns, Identical Pictures; Colorado Perceptual Speed
Godinez et al. (2012)	CLTS	17.3±0.6 [15.8–20.1]	MZ: 191; DZ: 165; SIB: 40	WCST*
Hansell et al. (2005)	MAPS	16.2±0.3 [15.4–18.1]	MZ: 252; DZ: 297	FIQ; SDRT Accuracy*; Choice RT 2-choice Mean RT; Line Discrimination Inspection Time
Hansell et al. (2015)	MAPS	17.0±2.2 [15.9–29.6]	MZ: 138; DZ: 199; SIB: 113	FIQ; Latin Square task*; N-term task*; Sentence Comprehension*; PC Relational Complexity; Composite of WAIS Matrix Reasoning + MAB Arithmetic; Composite of WAIS Digit Span Backwards + LNS
Haworth et al. (2010)	WRRP / TEDS / MCTFR / CLTS / CTS / CLDRC / MAPS / NTR	T3: 17 [14–34]	T2: MZ: 2222; DZ: 2712; T3: MZ: 1498; DZ: 1577	FIQ*
Keller et al. (2013)	CLTS / CTS / CFAM / MAPS	MZ/DZ: [12–28]; SIB: [10–35]	MZ: 1062; DZ: 1310; SIB: 1664	FIQ*
Luciano et al. (2001a)	MAPS	16.2±0.3 [15–18]	MZ: 184; DZ: 206	MAB VIQ, PIQ, FIQ; Line Discrimination
Luciano et al. (2001b)	MAPS	16.2±0.3 [15–18]	MZ: 166; DZ: 190	MAB FIQ; CRT; DRT
Luciano et al. (2003)	MAPS	16.2±0.3 [15–18]	MZ: 184; DZ: 206	MAB Information, Arithmetic, Vocabulary, Spatial, Object Assembly; WAIS Digit Symbol Coding
Luciano et al. (2004)	MAPS	16.2±0.3 [15–18]	MZ: 245; DZ: 298	MAB VIQ, PIQ; Line Discrimination; Choice RT; SDRT*
Luciano et al. (2005)	MAPS / NTR	MAPS: 16.2±0.3 [15–18] NTR: C1: 25.8±2.9 [<36] C2: 49.4±6.8 [36+]; SIB: 17.2±1.1 [15–22]	MZ: 385; DZ: 451; SIB: 670	MAB VIQ*, PIQ*; Line Discrimination
Luciano et al. (2006)	MAPS	QCST: 17.3±0.4 [16–18] MAB: MZ/DZ: 16.2±0.3 [15–18]; SIB: 17.2±1.1 [15–22]	MZ: 157-210; DZ: 166-288; SIB: 91-163	MAB VIQ, PIQ; QCST
Rijsdijk et al. (1998)	NTR	T1: 16.1±0.6 T2: 17.6±0.5	T1: MZ: 80; DZ: 108; T2: MZ: 74; DZ: 100	Simple RT*; Choice RT*; RSPM; WAIS Information, Comprehension, Arithmetic, Similarities, Digit Span, Vocabulary, Digit Symbol, Picture Completion, Block Design, Picture Arrangement, Object Assembly
Rijsdijk et al. (2002)	NTR	17.6±0.5	MZ: 83; DZ: 111	WAIS FIQ, VIQ, PIQ, Information*, Comprehension*, Arithmetic*, Similarities*, Digit Span*, Vocabulary, Digit Symbol Coding*, Picture Completion*, Block Design*, Picture Arrangement*, Object Assembly*, Index Scores; RSPM*
Rommel et al. (2015)	TEDS	T3: 16.5±0.3 [15.8–17.3]	MZ: 1745; DZ: 3026	Mill Hill Vocabulary Scale*; RPM*

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c,d]
Rowe et al. (1999a)	NLSAH	16.0±1.7 [13–18]	MZ: 176; DZ: 347	PPVT
Silventoinen et al. (2012)	MTFS	C2: 17.0±0.5 [16–17]	C2: MZ: 411; DZ: 215	WISC/WAIS FIQ*, PIQ*, VIQ*
Tosto et al. (2014b)	TEDS	16.6±0.3 [16–16]	MZ: 836; DZ: 1422	Number Sense Task
Wainwright et al. (2004)	MAPS	16.2±0.3 [15.4–18.2]	MZ: 225; DZ: 275	MAB Vocabulary*, Information*, Arithmetic*, Spatial*, Object*, Digit Symbol*; CCRT Reading; SGWRT Reading
Wainwright et al. (2005a)	MAPS	QCST: 17.3±0.4 [15.3–18.6] MAB: 16.2±0.4 [15.4–18.4]	MZ: 168-256; DZ: 199-326	MAB VIQ, PIQ; QCST
Wainwright et al. (2005b)	MAPS	QCST: 17.3±0.4 [15.3–18.6] MAB: 16.2±0.4 [15.4–18.4]	MZ: 182-261; DZ: 208-354	MAB VIQ, PIQ; QCST Comprehend & Collect, Structure & Sequence, Analyze, Assess & Conclude, Create & Present*, Apply Techniques & Procedures
Wainwright et al. (2008)	MAPS	QCST: 17.3±0.4 [15.3–18.6] MAB: 16.2±0.4 [15.4–18.4]	MZ: 168-256; DZ: 199-326	MAB VIQ, PIQ; QCST; Choice RT*; Line Discrimination
Wright et al. (2000)	MAPS	16.5 [16.2–17.3]	MZ: 28; DZ: 27	MAB FIQ
Wright et al. (2002)	MAPS	16.3±0.5 [15.4–20.1]	MZ: 218; DZ: 258	DRT; MAB FIQ
Young et al. (2009)	CLTS	T2: 17.4±0.6 [16.5–20.0]	MZ: 159; DZ: 134	Go / No Go; SCWT
YOUNG ADULT (ages 18-40; 39 studies)				
Ando et al. (2001)	KTP	19.9±3.5	MZ: 87; DZ: 62	Kyodai NX15 Spatial WM*, Verbal WM*
Anokhin et al. (2003)	MTR	21.7±2.8	MZ: 58; DZ: 25	WCST*
Baker et al. (1991)	UWO	25.2±8.4 [15–57]	MZ: 50; DZ: 32	VIQ*, PIQ*; Composite of RT tasks
Blokland et al. (2008)	MAPS	24.4±1.7 [21–27]	MZ: 29; DZ: 31	n-back; MAB FIQ
Blokland et al. (2011)	MAPS	23.6±1.8 [20–28]	MZ: 75; DZ: 66	n-back*; MAB FIQ
Bohlken et al. (2014)	NTR	MZ: 28.3±3.6; DZ: 28.0±5.2; SIB: 27.8±4.2	MZ: 24; DZ: 24; SIB: 20	WAIS-III FIQ
Bouchard et al. (1990)	MISTRA	39.9±11.8	MZ: 49; DZ: 25	CAB Numerical Ability, Spatial Ability, Memory Span, Flexibility of Closure, Mechanical Ability, Speed of Closure, Colorado Perceptual Speed*, Word Fluency, Inductive Reasoning, Associative Memory, Meaningful Memory, Vocabulary, Proverbs, Spelling; HFSC Mental Rotation, ETS Card Rotations, Minnesota Paper Form Board, Hidden Patterns, Cube Comparisons, Paper Folding, Vocabulary, Subtraction & Multiplication, Word Beginnings & Endings, Pedigrees, Things Categories, Different Uses, Visual Memory, Lines and Dots, Identical Pictures
Brouwer et al. (2014a)	UMCU / NTR	MZ: 31.1±9.0 [19.5–55.9]; DZ: 28.2±6.0 [19.1–51.6]; SIB: 28.0±3.1 [20.2–31.3]	MZ: 20; DZ: 27; SIB: 19	WAIS-III FIQ*, VIQ*, PIQ*
Fan et al. (2001)	PUC	[14–42]	MZ: 26; DZ: 26	Attentional Network Test*
Fletcher et al. (2014)	ATR	37.1±6.5 [18–67]	MZ: 100; DZ: 73	Composite of Operation-Word Span + Sentence-Letter Span
Grant et al. (2010)	VETR	19.6±1.5 [16–30]	MZ: 1774; DZ: 1429	AFQT Premorbid IQ
Hall (1996)	UPTS	MZ: 21.4±3.2; DZ: 21.8±2.6	MZ: 64; DZ: 46	WAIS Vocabulary*, Block Design*, Digit Span*, Digit Symbol Coding*; JOLO*; COWAT Phonemic Fluency*; TMT-A; TMT-B*; WCST*, WMS Logical Memory*, Visual Reproduction*; Grooved Pegboard*
Hoekstra et al. (2007)	NTR	T5: 18	MZ: 89; DZ: 120	RAKIT/WISC/WAIS VIQ, PIQ
Hoekstra et al. (2009)	NTR	C2: MZ/DZ: 18.2±0.2 [18–18]; SIB: 18.5±4.7	C2: MZ: 77; DZ: 109	WAIS VIQ; CVLT*; Phonemic Fluency*; Semantic Fluency*
Kochunov et al. (2016)	MTR	29.1±3.5 [22–36]	MZ: 57; DZ: 60; SIB: 246	NIH Toolbox Pattern Comparison Processing Speed Test*
Lyons et al. (2009)	VETSA	T1: 19.8±1.5 [16–31] T2: 55.4±2.5 [51–60]	T1: MZ: 1669; DZ: 1303 T2: MZ: 200; DZ: 170	AFQT

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c,d]
Malykh et al. (2005)	RSTR	21.7±3.3 [16–28]	MZ: 40; DZ: 40	WAIS FIQ*, VIQ*, PIQ*
Martin et al. (2009)	MAPS	18±3.0 [11.6–28.7]	MZ: 175; DZ: 302; SIB: 473	MAB Arithmetic, Information, Vocabulary; ART; CORE Reading & Spelling
Molenaar et al. (2013)	WRRP / TEDS / MCTFR / CLTS / CTS / CLDRC / MAPS / NTR	T4: 18.8±2.7 [17–34]	T4: MZ: 350; DZ: 308	FIQ
Mosing et al. (2014)	STR	40.7±7.7 [27–54]	MZ: 1210; DZ: 1358	RPM*
Nandagopal et al. (2010)	FSTR	21.3±1.1 [18+]	MZ: 25; DZ: 13	ETS Paired Associate Memory*, Digit Span*; Sentence Picture Verification*
Neubauer et al. (2000)	GOSAT	34.3±13.0 [18–70]	MZ: 169; DZ: 131	Spearman's 'g'*; LPS FIQ*, Vocabulary*, Reasoning*, Word Fluency*, Spatial; Embedded Figures Test*; Closure*; RAPM*; SMST*; PLMT*
Posthuma et al. (2001a)	NTR	C1: 26.2±4.2 [13.9–42.6] C2: 50.4±7.5 [29.1–71.0]	MZ: 102; DZ: 131; SIB: 189	Line Discrimination Task; VIQ, PIQ
Posthuma et al. (2001b)	NTR	C1: 26.2±4.2 [13.9–42.6] C2: 50.4±7.5 [29.1–71.0]	C1: MZ: 54; DZ: 73; SIB: 109 C2: MZ: 48; DZ: 58; SIB: 80	WAIS Verbal Comprehension Index, Working Memory Index, Processing Speed Index, Perceptual Organization Index
Posthuma et al. (2002a)	NTR	26.2±4.2 [13.9–42.6]	MZ: 24; DZ: 31; SIB: 25	FIQ
Posthuma et al. (2002b)	NTR	C1: 26.2±4.2 [13.9–42.6] C2: 50.4±7.5 [29.1–71.0]	MZ: 102; DZ: 131; SIB: 189	Eriksen Flanker Task*
Posthuma et al. (2003)	NTR	C1: 26.2±4.2 [13.9–42.6] C2: 50.4±7.5 [29.1–71.0]	MZ: 102; DZ: 131; SIB: 189	WAIS Verbal Comprehension Index*, Working Memory Index*, Processing Speed Index*, Perceptual Organization Index*
Pinel et al. (2013)	INSERM	MZ: 23.2; DZ: 22.3	MZ: 19; DZ: 13	Arithmetic*
Tambs et al. (1984)	OTSN	41±8.1 [30–57]	MZ: 40; DZ: 40	WAIS FIQ*, VIQ*, PIQ*, Information*, Comprehension*, Arithmetic*, Similarities*, Digit Span*, Vocabulary*, Digit Symbol Coding*, Picture Completion*, Block Design*, Picture Arrangement,* Object Assembly*, Verbal Comprehension Index*, Working Memory Index*, Perceptual Organization Index*
Taylor (2007)	FSTR	MZ: 23.3±12.3; DZ: 23.9±10.2 [18–83]	MZ: 80; DZ: 29	WCST; SCWT*
Shikishima et al. (2009)	KTP	24.9±4.4 [17–36]	MZ: 84; DZ: 19	Kyodai NX15 composites: verbal ability, spatial ability, reasoning
Silventoinen et al. (2006)	NTR	C2: T1: 16 [16–16] C2: T2: 18 [18–18] C3: 26.2±4.1 C4: 49.5±7.1	C2: T1: MZ: 88; DZ: 122 C2: T2: MZ: 83; DZ: 105 C3: MZ: 63; DZ: 85 C4: MZ: 190; DZ: 209	RAKIT/WISC/WAIS/GIT FIQ, VIQ
Simons et al. (2007)	EFPTS	27±7.5 [18–46]	MZ: 187; DZ: 111	PC of AVLT, SCWT, CST, TMT, LDST
Sundet et al. (1988)	NAF	[~18–22]	MZ: 757; DZ: 1093	Spearman's 'g'*
Suzuki et al. (2011)	KTP	MZ: 21.1±5.6; DZ: 21.1±6.7 *	MZ: 221; DZ: 98	HFSC Mental Rotation*
Swagerman et al. (2016)	NTR	37.7±20.9 [10–86]	MZ: 154; DZ: 173; SIB: 489	CNB PCET*, Penn CPT*, Penn Letter n-back*, Penn Word Memory*, Penn Face Memory*, VOLT*, JOLO*, Penn Matrix Reasoning*, Penn Verbal Reasoning*, Finger Tapping*, Mouse Practice Task*, Emotion Recognition*, Emotion Intensity Discrimination*, Age Differentiation*, Spearman's 'g'*
van Leeuwen et al. (2009b)	NTR	C2: MZ/DZ: 18.2±0.2 [18–18]; SIB: 18.5±5.7	C2: MZ: 77; DZ: 109; SIB: 93	WAIS Digit Span*; Corsi Block Tapping*; n-back*
Volk et al. (2006)	MOAFTS	21.4±1.4 [18–24]	MZ: 44; DZ: 51	WAIS Vocabulary*; Word List Learning*
Vuoksimaa et al. (2010)	FinnTwin12	22 [21–24]	MZ: 143; DZ: 215	HFSC Mental Rotation*

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c,d]
MIDDLE AGE (ages 41-65; 25 studies)				
Bartfai et al. (1991)	SATSA	41.9±6.4 [29–52]	MZ: 19; DZ: 14	Choice RT*; FIQ*
Docherty et al. (2014)	VETSA	56.1±2.6 [51–60]	MZ: 132; DZ: 92	AFQT Premorbid IQ
Finkel et al. (1995a)	MTSADA / SATSA	MTSADA: C1: 36±4.3 [27–49] MTSADA: C2: 61±3.1 [50–64] MTSADA: C3: 71±6.9 [65–88] SATSA: C4: 41±5.9 [27–49] SATSA: C5: 59±4.3 [50–64] SATSA: C6: 72±4.8 [65–85]	MTSADA: MZ: 132; DZ: 91 SATSA: MZ: 86; DZ: 110	WAIS Digit Span; WMS Logical Memory, Visual Reproduction; TPM; CAP Names & Faces; PC
Finkel et al. (1995b)	MTSADA / SATSA	MTSADA: C1: 38.9±4.4 MTSADA: C2: 60.1±3.9 MTSADA: C3: 69.3±5.8 [27–88] SATSA: C4: 41.1±5.9 SATSA: C5: 58.8±4.3 [27-64] SATSA: C6: 71.6±4.8 [65–85]	MTSADA: MZ: 119; DZ: 72 SATSA: MZ: 93; DZ: 134	WAIS Information*, Block Design*, Digit Symbol Coding*, Digit Span*
Finkel et al. (1998a)	MTSADA	C1: 43.4±8.3 [27–59] C2: 69.8±10.5 [60–94]	MZ: 201; DZ: 140	Word Recall from Line Drawings*; WMS Logical Memory*, Visual Reproduction*; PC
Finkel et al. (2007)	MTSADA	58.7 [27–95]	MZ: 185; DZ: 131	PC of 12 Simple RT and Choice RT tests
Goldberg et al. (2013)	MTS / UOB	MZ: 37.6±13.0 [17–65]; DZ: 40.6±13.5 [17–65]	MZ: 186; DZ: 78	WAIS FIQ*, Letter-Number Sequencing*
Johnson et al. (2005)	MISTRA	42.7±13.6 [18–79]	MZ: 44; DZ: 33; SIB: 2	HFSC Pedigrees*; CAB Flexibility of Closure, Inductive Reasoning; MISTRA Reading Comprehension*, Spelling*; Slosson Word Recognition*; WRMT Word Identification*
Johnson et al. (2007b)	MISTRA	42.7±13.6 [18–79]	MZ: 74; DZ: 52	WAIS Information*, Comprehension*, Vocabulary*, Digit Symbol Coding*, Arithmetic*, Similarities*, Digit Span*, Picture Completion*, Block Design*, Picture Arrangement*, Object Assembly*; PC; Spearman's '*g*'*; RPM*; CAB Numerical Ability, Spatial Ability*, Memory Span, Flexibility of Closure*, Mechanical Ability*, Speed of Closure*, Perceptual Speed*, Word Fluency*, Inductive Reasoning*, Associative Memory, Meaningful Memory, Vocabulary, Proverbs*, Spelling*; Minnesota Paper Form Board*; ETS Card Rotations*, Hidden Patterns*, Identical Pictures*, Cube Comparisons*, Paper Folding*, Vocabulary, Subtraction & Multiplication*, Word Beginnings & Endings*, Pedigrees, Things Categories*, Different Uses; HFSC Lines and Dots*, Picture Memory*, Mental Rotation*
Kremen et al. (2005)	VETR	MZ: 47.8±3.6; DZ: 47.9±2.9 [41–58]	MZ: 177; DZ: 169	WRAT Reading*
Kremen et al. (2007b)	VETR	47.9±3.3 [41–58]	MZ: 173; DZ: 166	WMS Digit Span*; WRAT Reading; Reading Span*
Kremen et al. (2009)	VETR	47.9±3.3 [41–58]	MZ: 173; DZ: 166	Tower of London*
Kremen et al. (2011a)	VETR	47.9±3.3 [41–58]	MZ: 161; DZ: 155	SDRT*; ODRT*
Kremen et al. (2011b)	VETSA	55.4±2.5 [51–60]	MZ: 349; DZ: 265	CPT-AX*
Kremen et al. (2014)	VETSA	55.4±2.5 [51–59]	MZ: 349; DZ: 265	CVLT*; WMS Logical Memory*, Visual Reproduction*
Panizzon et al. (2011)	VETSA	MZ: 55.3±2.5; DZ: 55.6±2.4	MZ: 323; DZ: 250	CVLT*
Panizzon et al. (2014)	VETSA	55.4±2.5 [51–59]	MZ: 346; DZ: 265	WASI Vocabulary, Matrix Reasoning; WMS Digit Span*, Letter-Number Sequencing*; AFQT Vocabulary*, Box Folding*; THFT*; TMT-A
Panizzon et al. (2015)	VETSA	T1: 55.8±2.5 [51–59] T2: 61.6±2.4	T1: MZ: 349; DZ: 265 T2: MZ: 269; DZ: 203	CVLT; WMS Logical Memory, Visual Reproduction
Rose et al. (1981)	KMTP-IUTP	[6–62]	MZ: 57; DZ: 127	ETS Identical Pictures*
Vasilopoulos et al. (2012a)	VETSA	55.4±2.5 [51–60]	MZ: 349; DZ: 270	WAIS Vocabulary*, Matrix Reasoning*; Semantic Fluency*; AFQT; Composites of THFT+ ETS Card Rotations, WMS Logical Memory + Visual Sequencing, DKEFS TMT-2 + TMT-3 + SCWT, TMT-4 + Category Switching
Vasilopoulos et al. (2012b)	VETSA	55.4±2.5 [51–60]	MZ: 342; DZ: 266	TMT-A; TMT-B
van den Berg et al. (2004)	NTR	T1: 44 [34–63] T2: C1: 26 [18–34] T2: C2: 49 [36–71]	T1: MZ: 95; DZ: 118 T2: MZ: 144; DZ: 172	GIT Vocabulary*
Vinkhuyzen et al. (2010)	NTR	36.7±12.6 [13–70]	MZ: 93; DZ: 91; SIB: 164	SMST*
Vinkhuyzen et al. (2012)	NTR	46.6±12.4 [23–75]	MZ: 136; DZ: 152; SIB: 265	WAIS FIQ
Vuoksimaa et al. (2015)	VETSA	55.7±2.6 [51–60]	MZ: 131; DZ: 96	AFQT Premorbid IQ, Verbal Ability*, Arithmetic*, Tool/Mechanical Reasoning*, Spatial Processing*
OLDER (ages 65+; 35 studies)				
Carmelli et al. (2002a)	NHLBI	73.0±3.0 [69–80]	MZ: 72; DZ: 70	PC of SCWT + Verbal Fluency + Digit Symbol + TMT-A + TMT-B; MMSE
Carmelli et al. (2002b)	NHLBI	MZ: 72.3±3.0; DZ: 71.8±2.9 [69–80]	MZ: 72; DZ: 67	PC of MMSE + ISBMD + SCWT + CVLT + Digit Symbol + TMT-A + TMT-B
Doty et al. (2011)	LSADT	F: 83.1±5.3; M: 80.3±4.6 [70–100]	MZ: 99; DZ: 110	Composite of MMSE + Semantic Fluency + Digit Span + Word List Learning
Finkel et al. (1993)	MTSADA	MZ: 66.6±6.7; DZ: 67.9±6.7 [60–88]	MZ: 93; DZ: 67	Word Recall; WMS Logical Memory*, Visual Reproduction
Finkel et al. (2000a)	SATSA	64±8 [40–84]	MZ: 112; DZ: 180	WAIS Digit Symbol Coding*, Information, Block Design, Digit Span*; DSB Figure Identification*, Synonyms*, Figure Logic*; WIT-III Analogies*; ETS Card Rotations*; TPM; CAP Names & Faces*; PC
Finkel et al. (2000c)	SATSA	[44.8–82.1]	MZ: 95; DZ: 11	WAIS Information, Block Design, Digit Span; ETS Card Rotations
Finkel et al. (2004)	SATSA	[50–96]	T1: MZ: 240; DZ: 400 T2: MZ: 216; DZ: 374 T3: MZ: 206; DZ: 356	WAIS Information*, Block Design*; TPM*; Spearman's '*g*'*
Finkel et al. (2005)	SATSA	63.9±9.2 [27–85]	MZ: 112; DZ: 180	PC of WAIS Information + Block Design + Digit Span; WIT-III Analogies; DSB Figure Logic, Synonyms, Figure Identification; ETS Card Rotations; TPM; CAP Names & Faces; Symbol Digit
Finkel et al. (2009)	SATSA	69.7±7.7 [50.0–88.9]	MZ: 329; DZ: 541	PC of Information + Synonyms + Analogies; PC of Figure Logic + Block Design + ETS Card Rotations; PC of Digit Span + Picture Memory + Names & Faces; PC of Symbol Digit + Figure Identification
Finkel et al. (2014)	SATSA	69.7±7.7 [54.3–89.2]	MZ: 32; DZ: 48	Simple RT + Choice RT mean/range Decision Time*, mean/range Movement Time*; WAIS-R PC
Giubilei et al. (2008)	ITR	MZ: 67.9±4.8; DZ: 76.5±4.7 [62–80]	MZ: 35; DZ: 58	Token Test*; RCPM*; Phonemic Fluency*; Semantic Fluency*; Attentional Matrices; BVRT Copying Drawings*; Story Recall*
Johnson et al. (2009)	LSADT	76.0±4.6 [70–100]	MZ: 464; DZ: 619	Semantic Fluency; WAIS Digit Span; Word List Learning
Lee et al. (2012a)	OATS	71.0±5.2 [65–88]	MZ: 117; DZ: 98	WAIS Digit Span*; COWAT Phonemic Fluency*; SCWT*; TMT-B/A*; Spearman's '*g*'
Lee et al. (2012b)	OATS	70.7±5.2 [65–88]	MZ: 119; DZ: 99	WAIS-III Digit Symbol Coding*; TMT-A*; SCWT*; Simple RT*; Choice RT*; Spearman's '*g*'*
Lessov-Schlaggar et al. (2007)	NHLBI	T1: 63.1±2.9 [59–70] T2: 72.3±3.0 [68–80] T3: 76.6±1.9 [71–83]	T1: MZ: 137; DZ: 129 T2: MZ: 94; DZ: 91 T3: MZ: 56; DZ: 57	WAIS Digit Symbol; SCWT*; TMT-B
McArdle (2006)	SATSA	71.8±4.9 [65–88]	MZ: 34; DZ: 59	WAIS Information
McArdle et al. (2009)	NASTR	66.5 [59–75]	MZ: 2987; DZ: 3453	TICS Word List Learning*
McClearn et al. (1997)	STR	82.3 [80–100]	MZ: 110; DZ: 130	Spearman's '*g*'; WAIS FIQ; WAIS Digit Symbol; Composites DSB Synonyms + Information, Figure Logic + Block Design; WAIS Digit Span + HFSC Picture Memory
McGue et al. (2001)	LSADT	MZ: 80.0±5.9; DZ: 79.4±5.5 [75+] [e]	MZ: 168; DZ: 235	Semantic Fluency*; Digit Span*; CVLT; Spearman's '*g*'; MMSE

Reference	Cohort[a]	Age (M±SD [range])	Sample size	Neuropsychological phenotypes[b,c,d]
McGue et al. (2002)	LSADT	75.7±4.5 [70–96]	MZ: 408; DZ: 582	Spearman's 'g'
McGue et al. (2007)	LSADT	77.4±5.5 [70–102]	MZ: 451; DZ: 661	MMSE; Spearman's 'g'*
Pedersen et al. (1992)	SATSA	65.6±8.4 [27–85]	MZ: 67; DZ: 89	Spearman's 'g'; WAIS Information, Digit Symbol, Digit Span; DSB Synonyms, Figure Logic, Figure Identification; Koh's Block Design; WIT Analogies; ETS Card Rotations; CAP Names & Faces; TPM
Pedersen et al. (1996)	SATSA	66.3±7.6 [50–88]	MZ: 99; DZ: 150	MMSE; Composite of DSB Synonyms + Figure Logic + Figure Identification + Block Design
Plomin et al. (1994)	SATSA	64.1±7.5 [27–85]	MZ: 82; DZ: 141	Koh's Block Design; ETS Card Rotations; DSB Figure Logic, Synonyms, Figure Identification; WAIS Information, Digit Symbol; WIT-III Analogies; CAP Names & Faces; TPM
Read et al. (2006)	STR	MZ: 80.5±8.7; DZ: 77.7±12.0[e]	MZ: 99-153; DZ: 337-468	WAIS Block Design*, Digit Span*, Digit Symbol Coding*; DSB Synonyms*; TPM*; Spearman's 'g'*
Reynolds et al. (2002)	SATSA	C1: [44.5–65] C2: [66–90.9]	C1: MZ: 65; DZ: 106 C2: MZ: 65; DZ: 106	Koh's Block Design; TPM; Symbol Digit Modalities
Reynolds et al. (2005)	SATSA	65.0±8.2 [27–85]	MZ: 135; DZ: 221	WAIS Information, Digit Span, Digit Symbol Coding; WIT-III Analogies; DSB Synonyms, Figure Logic, Figure Identification; Koh's Block Design; ETS Card Rotations; TPM; Spearman's 'g'
Singer et al. (2006)	TwinsUK	56 [18–76]	MZ: 108; DZ: 170	CANTAB composites; NART Reading*; Simple RT + Choice RT*
Steves et al. (2013)	HATS	T1: 55.5±7.8 [42–72] T2: MZ: 66.6±7.6; DZ: 65.8±7.2 [52–83]	T1: MZ: 95; DZ: 149 T2: MZ: 63; DZ: 98	CANTAB Choice RT*, Simple RT*, Paired Associates Learning*, Pattern Recognition Memory*, Delayed Matching to Sample*, Spatial Span*, Spatial Working Memory*, PC, Spearman's 'g'*
Svedberg et al. (2009)	SATSA	67±9.3 [50–84]	MZ: 146; DZ: 146	WAIS Information, Digit Span; Koh's Block Design; TPM; Symbol Digit Modalities
Swan et al. (1990)	NHLBI	63.1±2.9 [59–70]	MZ: 134; DZ: 133	Composite; MMSE; WAIS Digit Symbol Coding*
Swan et al. (1999)	NHLBI	71.8±2.9 [68–80]	MZ: 94; DZ: 89	CVLT
Swan et al. (2002)	NHLBI	71.5±2.6 [68–80]	MZ: 80; DZ: 78	SCWT; Phonemic Fluency*; WAIS Digit Symbol Coding; TMT-B; PC
Tucker-Drob et al. (2014)	SATSA	[50–96]	MZ: 160; DZ: 265	Composites; Spearman's 'g'
Xu et al. (2015)	QTR	51.6 [33–80]	MZ: 244; DZ: 140	Digit Span*; MoCA

[a]For cohort name abbreviations see Supplementary Table 1.
[b]For test name abbreviations see Supplementary Table 9.
[c]Asterisk (*) indicates phenotypes included in meta-analyses.
[d]Semicolons separate instruments, commas separate subtests of same instrument.
[e]Ages were reported for five zygosity groups; averages for MZ and DZ were calculated [average SD = $\Sigma(SD^2)$].
Abbreviations: MZ = Monozygotic (n pairs); DZ = Dizygotic (n pairs); SIB = Siblings; PC = Principal Component; T = Time; C = Cohort.

Supplementary Table 6 – Characteristics of Non-Psychiatric Family/Pedigree Studies

Reference	Cohort[a]	Age (M±SD [range])	Sample size (n individuals [n families])	Neuropsychological phenotypes[b,c,d]
Chen et al. (2009)	CCNMD	20.6±0.5; Relatives: 19.7±0.5	157 [77]	WAIS/WMS Matrix Reasoning*, Digit Span*, Spatial Span*, Letter-Number Sequencing*, Logical Memory*, Family Pictures*; n-back*; CVLT*; Semantic + Phonemic Fluency*; TMT-B*; WCST*; CPT-DS*; CPT-AX*; CPT-IP*; Composites
Galimberti et al. (2013)	INSPE	28.6±11.9; Relatives: 3.1±13.6	58 [29]	Iowa Gambling Task*; WCST*
Glahn et al. (2013)	GOBS	44.2±14.0 [18–83]	1129 [81]	WAIS FIQ*, Letter-Number Sequencing, Digit Span, Digit Symbol Coding, Matrix Reasoning*, Vocabulary*; Digit Symbol Recall*; Phonemic Fluency; Semantic Fluency; TMT-A; TMT-B; CPT-IP; SDRT; CVLT*; CNB Penn Face Memory*, Emotion Recognition, PCET
Greenwood et al. (2011)	SCA	Nonagenarian: 93.4±3.0; Offspring: 66.4±5.0	253 [65]	WAIS Similarities*; Word List Memory*; WMS Logical Memory; TMT-A + TMT-B*; Semantic Fluency + Phonemic Fluency*; Target Cancellation; Composites
Hart et al. (2010)	CNLSY	9.6±2.7 [4.9–14.8]	924-9376 [2400]	PIAT Reading, Mathematics; PPVT
Karlsgodt et al. (2010)	GOBS	47.8±13.5 (19–85)	462 [32]	SDRT; WAIS Digit Span, Letter-Number Sequencing
Knowles et al. (2014)	GOBS	44.8±15.2 [18–97]	1269 [75]	WAIS Letter-Number Sequencing*, Digit Span*, Digit Symbol Coding*; Digit Symbol Recall*; Phonemic Fluency*; Semantic Fluency*; TMT-A*; TMT-B*; CPT-IP*; SDRT*; CVLT*; CNB Penn Face Memory*, Emotion Recognition*, PCET*
Kochunov et al. (2016)	OOA	48.7±17.1 [18–75]	145 [17]	WAIS Digit Symbol Coding*
Luciano et al. (2010)	SFHS	47.4±14.5 [18–99]	6118 [1983]	WAIS Digit Symbol Coding*; WMS Logical Memory; Semantic Fluency + Phonemic Fluency*; Mill Hill Vocabulary*; Spearman's 'g'*
Matteini et al. (2010)	LLFS	72.5±16.4 [31–110]	3224 [480]	WAIS Digit Span*; Semantic Fluency; CERAD Word List Memory*
Rowe et al. (1999b)	CNLSY	[14–23]	4460 [2230]	AFQT
Sleegers et al. (2007)	ERF	50.2±14.3 [18+]	780 [1]	RAVLT*; Semantic Fluency*; SCWT*; TMT-B*
Smalley et al. (1989)	UCLA	[12+]	73 [1]	ETS Cube Comparisons*, Card Rotations*, Hidden Patterns*; HFSC Mental Rotation*; LPS Embedded Figures Test*

[a]For cohort name abbreviations see Supplementary Table 1.
[b]For test name abbreviations see Supplementary Table 9.
[c]Asterisk (*) indicates phenotypes included in meta-analyses.
[d]Semicolons separate instruments, commas separate subtest of same instrument.

Supplementary Table 7 – Characteristics of Schizophrenia Family/Pedigree Studies

Reference	Cohort[a]	Age (M±SD [range])	Sample size (n individuals [n families])	Neuropsychological phenotypes[b,c,d]
Alfimova et al. (2003)	MHRC	Pro: 30±10; UA-REL: 44±15	199 [72]	PC
Aukes et al. (2008)	UMCU	Pro: 40.7±14.7; UA-REL: 48.6±16.9	180 [25]	Semantic Fluency*; WMS Spatial Span*
Aukes et al. (2009)	UMCU	Pro: 40.7±14.7; UA-REL: 48.6±16.9	133 [24]	WAIS FIQ*
Bertisch et al. (2010)	NAMI	[13–56]	110 [47]	WAIS Vocabulary*, Similarities*, Information*, Block Design*, Matrix Reasoning*, Digit Span*, Digit Symbol Coding*, Letter-Number Sequencing*; WRAT Reading*, Spelling*, Arithmetic*; CVLT*; WMS Verbal Paired Associates*, Visual Reproduction*; BNT*; PPVT*; COWAT Phonemic Fluency*; SCWT*; TMT-A*; TMT-B*; Finger Tapping*; Purdue Pegboard*; PC; Spearman's 'g'*
Calkins et al. (2010)	PAARTNERS	Pro: 39.9±11.6; UA-REL: 45.6±15.8	1538 [491]	CNB PCET*, Penn CPT, Penn Word Memory*, Penn Face Memory*, Penn Verbal Reasoning*, VOLT*, Penn Letter n-back*, JOLO*, Finger Tapping, Mouse Practice Task, Emotion Recognition/Discrimination
Chen et al. (1998)	MPSS	Pro: 30.7±8.0; UA-REL: 46.9±16.2; CON: 32.3±7.6; CON-REL: 38.4±14.8	270 [80]	CPT-DS*, CPT-19*
Chen et al. (2009)	CCNMD	Pro: 22.7±0.4; UA-REL: 22.0±0.5; CON: 20.6±0.5; CON-REL: 19.7±0.5	SCZ: 278 [133]; CON: 157 [77]	WAIS/WMS Matrix Reasoning*, Digit Span*, Spatial Span*, Letter-Number Sequencing*, Logical Memory*, Family Pictures*; n-back*; CVLT*; Semantic + Phonemic Fluency*; TMT-B*; WCST*; CPT-DS*; CPT-AX*; CPT-IP*
Glahn et al. (2007)	GOBS / CVCR / MCM	SCZ: 37.5±15.0 [15–72]; BPD: 42.7±12.0 [18-59]; MDD: 35.1±10.0 [19-52]; Other Dx: 48.4±14.0 [24–70]; UA-1DR: 48.0±15.0 [19–79]; UA-2DR: 30.0±9 [20–51]; CON: 33.0±12.0 [15–63]	269 [104]	WAIS Digit Symbol Coding*; Digit Symbol Recall*; Digit Span*; Phonemic Fluency*; Semantic Fluency*; TMT-A*; TMT-B*; CPT-IP*; SDRT*; CVLT*; RPM*; AIM Abstraction
Glahn et al. (2014)	GOBS	SCZ: 46.9±13.5; UA-1DR: 49.4±12.5; UA-2DR: 454.1±22.1; UA-3DR: 52.1±10.2; UA-4DR: 34.6±12.6; UA-5DR: 35.8±16.2; UA-6DR: 34.1±5.8; UA-7DR: 20.6±2.0; CON: 44.3±15.5	1606 [75]	WAIS FIQ*, Letter-Number Sequencing*; Digit Span; Digit Symbol Coding; Matrix Reasoning*; Vocabulary*; Phonemic Fluency; Semantic Fluency; TMT-A; TMT-B; CPT-IP*; SDRT; CVLT; CNB Penn Face Memory*; PCET*, Emotion Recognition*
Greenwood et al. (2007)	COGS	Pro: 34.2±10.8; AF-SIB: 45.0±12.9; UA-SIB: 36.9±11.4; UA-PAR: 62.3±10.6 [18–65]	609 [183]	CPT-DS; CVLT; UMD Letter-Number Span; CNB PCET, Penn Face Memory, VOLT, JOLO, Mouse Practice Task, Emotion Recognition
Greenwood et al. (2013)	COGS	[18–65]	949 [296]	CPT-DS; CVLT*; UMD Letter-Number Span*; CNB PCET*, Penn Face Memory*, VOLT*, JOLO*, Mouse Practice Task*, Emotion Recognition*
Gur et al. (2007)	PMFS	Pro: 45.3±13.0; UA-REL: 43.8±17.8; CON: 41.9±17.9	430 [35]	CNB PCET*, Penn CPT*, Penn Word Memory*, Penn Face Memory*, VOLT*, JOLO*, Finger Tapping, Mouse Practice Task*, Emotion Intensity Discrimination*
Hill et al. (2013)	B-SNIP	SCZ: 35.9±12.8; SADD: 38.2±11.9; SADM: 35.8±11.7; UA-REL SCZ: 43.2±15.0; UA-REL SADD: 41.7±15.9; UA-REL SADM: 40.1±16.6; PBPD: 36.2±12.8; UA-REL PBPD: 40.5±15.9	SCZ: 971 [458]; BPD: 486 [227]	WRAT Reading*; BACS Composite, List Learning*, Digit Sequencing*, Token Test*, Verbal Fluency (Semantic + Phonemic Fluency)*, Symbol Coding*, TOL*
Husted et al. (2009)	CAMH	SCZ: 51.8±9.5; UA-REL: 49.1±10.5	83 [17]	WAIS FIQ*, Digit Symbol Coding*, Digit Span*; WMS Visual Reproduction*, Logical Memory*; Purdue Pegboard*; TMT-A*; TMT-B*; RAVLT*; WCST*
Lin et al. (2013)	MPSS / TSLS / SEFOS	Multiplex Pro: 35.0±7.7; UA-PAR: 63.0±8.7; UA-SIB: 36.7±8.7; Simplex Pro: 31.7±8.0; UA-PAR: 56.3±7.8; UA-SIB: 33.4±9.2	2300 [821]	WCST*
Mendoza Quiñones et al. (2009)	CMHHC	Pro: 36.2±11.1; UA-REL: 47.4±14.0	225 [80]	TMT-A*; TMT-B*
Seidman et al. (2015)	COGS	Pro: 32.4±10.0; UA-REL: 35.9±11.4; CON: 34.8±12.7 [18–65]	SCZ: 234 [83]; CON: 209 [209]	PC
Tuulio-Henriksson et al. (2002)	NPHIF	Pro (F/M): 48.5±7.6; 45.6±7.6; UA-REL (F/M): 48.0±7.3; 46.1±8.2	264 [131]	WAIS Vocabulary*, Similarities*, Block Design*, Digit Symbol Coding*; WMS Digit Span*, Visual Span*; CVLT*
Wang et al. (2010)	SUCC	Pro: 23.2±7.5; CON: 34.5±3.2; PAR: 47.9±8.2; SIB/OFF: 26.1±6.4	740 [214]	PC
Wiener et al. (2013)	PAARTNERS	Pro: 39.9±11.6; UA-REL: 45.6±15.8	1606 [514]	CNB PCET*, Penn CPT, Penn Face Memory*, Penn Word Memory*, Penn Verbal Reasoning*, Penn Letter n-back*, VOLT*, JOLO*

[a]For cohort name abbreviations see Supplementary Table 1. [b]For test name abbreviations see Supplementary Table 9. [c]Asterisk (*) indicates phenotypes included in meta-analyses. [d]Semicolons separate instruments, commas separate subtests of same instrument. Abbreviations: Pro = probands; SIB = Siblings; PAR = Parents; OFF = Offspring; CON = controls; AF = affected; UA = unaffected; REL =

Supplementary Table 8 – Characteristics of Schizophrenia Twin Studies

Reference	Cohort[a]	Age (M±SD [range])	Sample size [% SCZ]	Neuropsychological phenotypes[b]	r_g (95% CI)	r_c (95% CI)	r_e (95% CI)	r_{ph} (95% CI)	$r_{ph\text{-}a}$ (95% CI)	$r_{ph\text{-}c}$ (95% CI)	$r_{ph\text{-}e}$ (95% CI)
Fowler et al. (2012)	STR / SYMTS	37.0±10.1	MZ: 3379; DZ: 3904; SIB pairs: 369,960 [3%]	SEB Premorbid IQ	-0.26 (-0.37; -0.06)	-0.15 (-0.32; 0)	-0.06 (-0.33; -0.01)	-0.11			
Owens et al. (2011a)	MTS	MZ CCA: 38.1±9.9 [22–60]; MZ DCA: 30.3±10.11 [20–53]; MZ DCU: 30.1±10.1 [20–53]; MZ Con: 41.7±12.8 [19–71]; DCA: 40.6±11.5 [24–60]; DCU: 39.6±11.6 [21–60]; DZ Con: 42.2±11.1 [19–58]	MZ: 91; DZ: 48 [27%]	FIQ	-0.69 (-1; -0.52)	-1 (-1; 0)	-0.18 (-0.63; 0)	-0.64 (-0.73; -0.53)	-0.49 (-0.51; -0.30)	-0.12 (-0.25; 0)	-0.03 (-0.09; 0)
				WMS Verbal Paired Associates IR	-0.26 (-1; 0)	-1 (1; 0)	-0.24 (0.64; 0)	-0.26 (-0.38; -0.14)	-0.17 (-0.34; 0)	-0.05 (-0.23; 0)	-0.05 (-0.12; 0)
				WMS Verbal Paired Associates DR	-0.39 (-1; 0)	-1 (-1; 0)	0 (-0.34; 0)	-0.22 (-0.33; -0.11)	-0.22 (-0.33; 0)	0 (-0.23; 0)	0 (-0.08; 0)
				WMS Visual Paired Associates IR	-0.71 (-1; -0.28)	-0.39 (-1; 0)	-0.04 (-0.46; 0)	-0.41 (-0.51; -0.31)	-0.36 (-0.51; -0.08)	-0.05 (-0.24; 0)	-0.01 (-0.10; 0)
				WMS Visual Paired Associates DR	-0.09 (-1; 0)	-1 (-1; 0)	-0.19 (-0.59; 0)	-0.24 (-0.36; -0.13)	-0.04 (-0.31; 0)	-0.17 (-0.26; 0)	-0.04 (-0.12; 0)
				WMS Logical Memory IR	-0.58 (-1; -0.29)	-1 (-1; 0)	-0.07 (-0.55; 0)	-0.40 (-0.51; -0.30)	-0.35 (-0.49; -0.12)	-0.04 (-0.22; 0)	-0.02 (-0.12; 0)
				WMS Logical Memory DR	-0.58 (-1; -0.33)	-0.93 (-1; 0)	-0.21 (-0.64; 0)	-0.48 (-0.58; -0.37)	-0.33 (-0.54; -0.13)	-0.11 (-0.24; 0)	-0.04 (-0.13; 0)
				WMS Visual Reproduction IR	-0.99 (-1; 0)	-0.12 (-1; 0)	-0.29 (-0.73; 0)	-0.30 (-0.41; -0.18)	-0.22 (0.36; 0)	-0.03 (0.27; 0)	-0.05 (-0.14; 0)
				WMS Visual Reproduction DR	-0.55 (-1; -0.07)	0 (-1; 0)	-0.38 (-0.72; 0)	-0.37 (-0.47; -0.25)	-0.30 (-0.41; -0.03)	0 (-0.23; 0)	-0.06 (-0.13; 0)
Owens et al. (2011b)	MTS	MZ CCA: 37.2±9.7 [21–60]; MZ DCA: 34.5±11.1 [21–65]; MZ DCU: 34.7±11.4 [21–65]; MZ Con: 43.1±12.6 [19–71]; DCA: 38.6±11.5 [22–60]; DCU: 38.5±11.8 [21–60]; DZ Con: 42.7±12.7 [19–60]	MZ: 121; DZ: 79 [25%]	TMT-A Time	0.84 (0.41; 1)	-0.45 (-1; 1)	0.17 (-0.22; 0.54)	0.46 (0.39; 0.56)	0.49 (0.18; 0.63)	-0.04 (-0.16; 0.23)	0.03 (-0.04; 0.11)
				TMT-B Time	1 (0.60; 1)	-0.64 (-1; 1)	0.28 (-0.08; 0.60)	0.54 (0.45; 0.62)	0.58 (0.31; 0.67)	-0.09 (-0.16; 0.17)	0.05 (-0.01; 0.11)
				TMT-B - TMT-A Difference	1 (0.42; 1)	-1 (-1; 1)	0.25 (-0.12; 0.61)	0.41 (0.31; 0.49)	0.47 (0.22; 0.55)	-0.12 (-0.17; 0.11)	0.05 (-0.03; 0.13)
				Phonemic Fluency	-0.67 (-1; -0.24)	1 (-1; 1)	0.08 (-0.33; 0.49)	-0.30 (-0.40; -0.19)	-0.43 (-0.57; -0.16)	0.12 (-0.13; 0.21)	0.01 (-0.06; 0.09)
				Semantic Fluency	-0.88 (-1; -0.13)	0.58 (-1; 0)	-0.33 (-0.68; 0.06)	-0.37 (-0.46; -0.26)	-0.39 (-0.54; -0.04)	0.09 (-0.22; 0.20)	-0.07 (-0.14; 0.01)
Owens et al. (2012)	MTS / MFS	Pro: 35.8±10.5 [17–74]; UA-REL: 47.1±15.7 [16–85]; Con: 40.9±13.4 [18–77]	MZ: 151; DZ: 82; SIB: 510 [13%]	FIQ	-0.42 (-0.63; -0.25)	1 (-1; 1)	-0.46 (-0.82; -0.03)	-0.31 (-0.34; -0.24)	-0.33 (-0.45; -0.20)	0.07 (-0.02; 0.07)	-0.06 (-0.11; 0)
				PC: general executive control	-0.40 (-0.19; -0.65)	0.84 (-1; 1)	-0.08 (-0.25; 0.44)	-0.30 (-0.22; -0.37)	-0.29 (-0.13; -0.42)	0.01 (-0.10; 0.11)	-0.01 (-0.04; 0.07)
				PC: planning, strategy formation	-0.45 (-0.21; -0.78)	1 (-1; 1)	-0.16 (-0.18; 0.49)	-0.31 (-0.24; -0.38)	-0.31 (-0.14; -0.45)	0.02 (-0.12; 0.10)	-0.03 (-0.03; 0.09)
Toulopoulou et al. (2007)	MTS	MZ CC: 37.8±1.5; MZ DC: 29.7±2.3; MZ Con: 40.9±1.1; DZ DC: 37.6±3.7; DZ Con: 44.0±1.3	MZ: 92; DZ: 41 [27%]	FIQ	-0.75 (-1; -0.49)	-0.96 (-1; 1)	-0.09 (-0.70; 0.57)	-0.61 (-0.71; -0.48)	-0.56	-0.03	-0.01
				WAIS Working Memory Index	-0.79 (-1; -0.34)	0.79 (-1; 1)	-0.43 (-0.89; 0.31)	-0.51 (-0.62; -0.39)	-0.57	0.11	-0.05
				WAIS Processing Speed Index	-0.46 (-1; 1)	-0.98 (-1; 1)	-0.92 (-0.99; -0.46)	-0.57 (-0.70; -0.45)	-0.27	-0.13	-0.17
				WAIS Perceptual Organization Index	-0.61 (-1; -0.39)	-0.99 (-1; 1)	0.03 (-0.57; 0.62)	-0.53 (-0.63; -0.41)	-0.43	-0.11	0.01
				WAIS Verbal Comprehension Index	-0.34 (-0.96; -0.08)	-1 (-1; 1)	-0.14 (-0.60; 0.57)	-0.42 (-0.53; -0.30)	-0.21	-0.19	-0.02

Reference	Cohort[a]	Age (M±SD [range])	Sample size [% SCZ]	Neuropsychological phenotypes[b]	r_g (95% CI)	r_c (95% CI)	r_e (95% CI)	r_{ph} (95% CI)	$r_{ph\text{-}a}$ (95% CI)	$r_{ph\text{-}c}$ (95% CI)	$r_{ph\text{-}e}$ (95% CI)
Toulopoulou et al. (2010)	MTS / MFS / NIHSS / HNFS	Pro: 37.1±10.2; UA-REL: 41.8±13.9; Con: 38.9±12.9	MZ: 92; DZ: 41; Other Pro/REL: 1065 [49%]	FIQ	-0.46 (-0.52; -0.32)	0 (-0.10; 1)	-0.33 (-0.36; 0.18)	-0.38 (-0.46; -0.38)	-0.34 (-0.35; -0.33)	0 (0; 0)	-0.05 (-0.06; -0.05)
				WMS Visual Reproduction IR	-0.34 (-0.37; -0.32)	0 (-0.34; 0)	-0.75 (-0.77; -0.67)	-0.35 (-0.39; -0.27)	-0.25 (-0.25; -0.22)	0 (0; 0)	-0.10 (-0.09; -0.05)
				WMS Visual Reproduction DR	-0.50 (-0.67; -0.41)	0 (-0.31; 0)	-0.29 (-0.47; -0.21)	-0.37 (-0.38; -0.28)	-0.32 (-0.42; -0.21)	0 (0; 0)	-0.05 (-0.05; -0.02)
				WMS Verbal Paired Associates IR	-0.34 (-0.37; -0.32)	0 (-0.34; 0)	-0.75 (-0.77; -0.67)	-0.35 (-0.39; -0.27)	-0.25 (-0.25; -0.22)	0 (0; 0)	-0.10 (-0.09; -0.05)
				WMS Verbal Paired Associates DR	-0.50 (-0.67; -0.41)	0 (-0.31; 0)	-0.29 (-0.47; -0.21)	-0.37 (-0.38; -0.28)	-0.32 (-0.42; -0.21)	0 (0; 0)	-0.05 (-0.05; -0.02)
				WMS Logical Memory IR	-0.34 (-0.37; -0.32)	0 (-0.34; 0)	-0.75 (-0.77; -0.67)	-0.35 (-0.39; -0.27)	-0.25 (-0.25; -0.22)	0 (0; 0)	-0.10 (-0.09; -0.05)
				WMS Logical Memory DR	-0.50 (-0.67; -0.41)	0 (-0.31; 0)	-0.29 (-0.47; -0.21)	-0.37 (-0.38; -0.28)	-0.32 (-0.42; -0.21)	0 (0; 0)	-0.05 (-0.05; -0.02)
Toulopoulou et al. (2015)	MTS / MFS / UMCU / NPHIF / UOB / JUH	MZ CCA: 38.3±10.6; MZ DCA: 40.9±11.5; MZ DCU: 40.9±11.5; MZ CCU: 37.6±12.4; DZ DCA: 45.1±10.9; DZ DCU: 44.1±11.0; DZ CCU: 36.9±12.8	MZ: 395; DZ: 231 [16%]	FIQ	-0.62 (-0.89; -0.26)	0.46 (-0.90; 1)	-0.49 (-0.81; -0.10)	-0.46 (-0.57; -0.34)	-0.48 (-0.68; -0.2)	0.09 (-0.19; 0.23)	-0.07 (-0.12; -0.01)
				Composite of WMS Logical Memory IR, Visual Reproduction IR, Verbal Paired Associates, Digit Span, Visual Memory Span	-0.63 (-1; -0.43)	-1 (-1; 0.24)	-0.45 (-0.89; -0.04)	-0.86 (-1; -0.72)	-0.48 (-0.81; -0.29)	-0.28 (-0.37; 0.03)	-0.11 (-0.21; -0.01)
				Composite of WMS Logical Memory DR, Visual Reproduction DR	-0.67 (-1; -0.45)	-1 (-1; 1)	-0.57 (-0.87; -0.14)	-0.76 (-0.89; -0.63)	-0.64 (-0.92; -0.36)	-0.01 (-0.25; 0.20)	-0.11 (-0.18; -0.03)

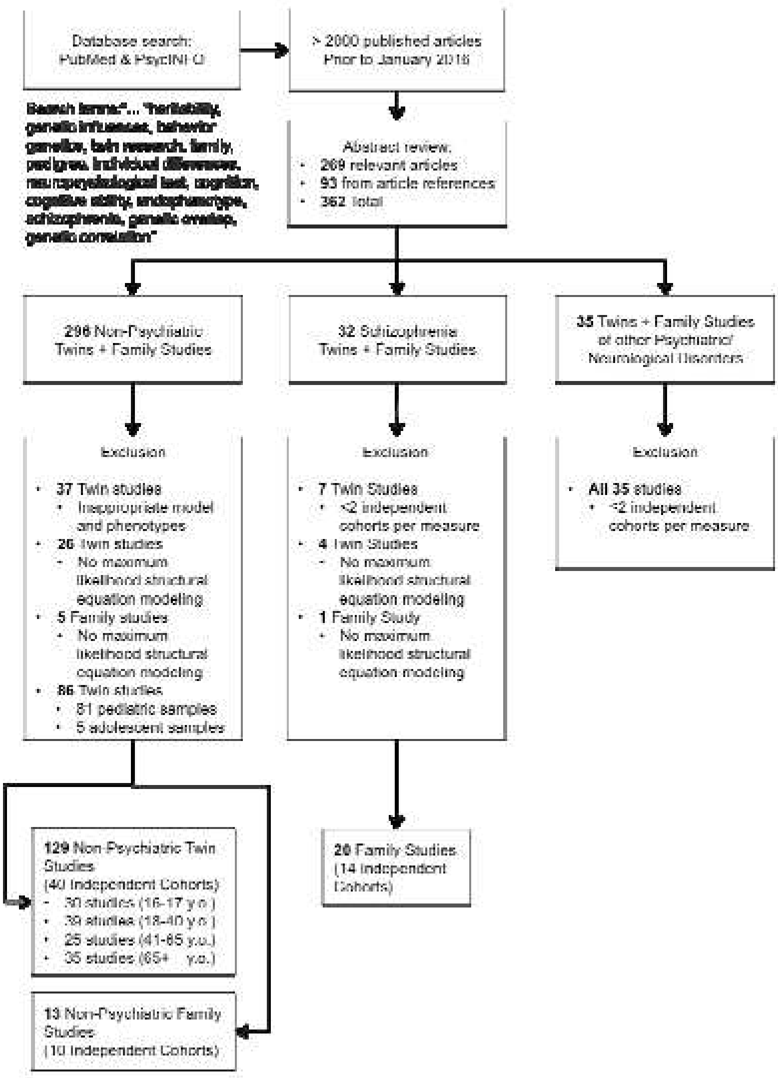
[a]For cohort name abbreviations see Supplementary Table 1.
[b]For test name abbreviations see Supplementary Table 9.
Abbreviations: MZ = Monozygotic (n pairs); DZ = Dizygotic (n pairs); SIB= Siblings; Pro = probands; Con = controls; UA = unaffected; REL = relatives; CCA, CCU = Concordant Affected, Unaffected; DCA, DCU = Discordant Affected, Unaffected; CI = Confidence Interval; FIQ = Full-scale Intelligence Quotient; r_g = genetic correlation; r_c = common environmental correlation; r_e = unique environmental correlation; r_{ph} = phenotypic correlation; $r_{ph\text{-}a}$ = part of phenotypic correlation explained by genetic factors; $r_{ph\text{-}c}$ = part of phenotypic correlation explained by common environmental factors; $r_{ph\text{-}e}$ = part of phenotypic correlation explained by unique environmental factors; SEB = Swedish Enlistment Battery; TMT = Trail Making Test; WAIS = Wechsler Adult Intelligence Scale; WMS = Wechsler Memory Scale; IR = Immediate Recall; DR = Delayed Recall.

Neuropsychological Test/Phenotype (organized by domain)*	Test Summary Score(s)	Test Reference(s)
General Cognitive Ability (GCA)		
Verbal IQ (VIQ)	VIQ from MAB; WAIS-III; RAKIT; WAIS; Norwegian adaptation of WAIS; WAIS-R; WISC-R; WISC-III	Wechsler (1955), Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Bleichrodt et al. (1984), Jackson (1984), Wechsler (1991), Wechsler (1997a)
Performance IQ (PIQ)	PIQ from MAB; WAIS-III; RAKIT; WAIS; Norwegian adaptation of WAIS; WAIS-R; WISC-R; WISC-III	Wechsler (1955), Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Bleichrodt et al. (1984), Jackson (1984), Wechsler (1991), Wechsler (1997a)
Full-scale IQ (FIQ)	FIQ from WAIS; WAIS-R; WAIS-III; LPS; MAB; prorated from MAB Information, Arithmetic, Vocabulary, Spatial and Object Assembly subtests; BMDI; PRIMA IQ Test; RAKIT; SBIS; WISC-III; RSPM; RCPM; WISC-R; WAIS-III, Dutch version; SRB; Norwegian adaptation of WAIS; WASI; WISC; WISC-III; prorated from WISC-III Vocabulary, Similarities, Picture Completion and Block Design subtests; WISC-R; prorated from WISC-R Similarities, Vocabulary, Block Design and Object Assembly subtests	Raven (1938), Raven (1947), Wechsler (1949), Wechsler (1955), Dureman et al. (1959), Bayley (1969), Terman et al. (1973), Wechsler (1974b), Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Bleichrodt et al. (1984), Jackson (1984), Thorndike et al. (1986), Wechsler (1991), Raven (1996), Wechsler (1997a), Wechsler (1999), Wechsler (2000), Webbink et al. (2006)
Spearman's g	Spearman's g from CANTAB; ETS GCA; CAT-3; LPS; BMDI; PARCA/MCDI-III, an extension of the short form MCDI: Words and Sentences; SBIS; Telephone Battery; WAIS; WAIS-III; WISC-R	Wechsler (1955), Horn (1962), Bayley (1969), Terman et al. (1973), Wechsler (1974a), Ekstrom et al. (1976), Thorndike et al. (1986), Kent et al. (1987), Robbins et al. (1994), Wechsler (1997a), Saudino et al. (1998), Fenson et al. (2000), Smith et al. (2001), Oliver et al. (2002)
Raven's Progressive Matrices	RSPM; RCPM; RAPM	Raven (1938), Raven (1947), Raven (1965), Raven et al. (1977), Raven (1994), Raven (1996)
AFQT	Total score	Uhlaner (1952)
MMSE	Total score/ index of global cognitive functioning from MMSE; Modified MMSE (3MSE)	Folstein et al. (1975), Folstein et al. (1983), Teng et al. (1987)
Attention/Processing Speed		
ETS	ETS Hidden Patterns; Identical Pictures	Ekstrom et al. (1976)
WAIS/WISC Digit Symbol/Coding	Digit Symbol/Coding subtest from WAIS; WAIS-R; WAIS-III; WAIS-IV; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC-R; WISC-IV	Wechsler (1955), Stinissen et al. (1970), Engvik et al. (1978), Wechsler (1981), Wechsler (1997a), Wechsler (2003), Wechsler (2008)
TMT	TMT-A time to completion; TMT-B time to completion	Reitan (1958)
Choice RT	Mean RT from CANTAB; CAT; Span of Apprehension Test; 2-4-8-choice task; 2-choice task; 4-choice task; 8-choice task; 4-choice FastTask	Asarnow et al. (1982), Detterman (1990), Robbins et al. (1994), Rijsdijk et al. (1998), Hansell et al. (2001), Luciano et al. (2001b), Kuntsi et al. (2005), Sachdev et al. (2010)
Simple RT	Mean RT from CANTAB; CAT; Simple RT experimental tasks	Detterman (1990), Robbins et al. (1994), Rijsdijk et al. (1998), Kuntsi et al. (2005), Sachdev et al. (2010)
PCET	Reaction time score	Kurtz et al. (2004)
Penn Word Memory	Reaction time score	Gur et al. (1993)
Penn Face Memory	Reaction time score	Gur et al. (1993)
VOLT	Reaction time score	Glahn et al. (1997)
JOLO, computerized version	Reaction time score	Gur et al. (2001)
Colorado Perceptual Speed	Accuracy score	DeFries et al. (1981)
SCWT	Stroop Interference score; Stroop Color-Word score (# of words completed)	Golden et al. (1978)
Attention/Vigilance		
CPT-Degraded Stimulus	d-prime	Nuechterlein et al. (1983), Chen et al. (1998), Nuechterlein et al. (1999)
Working Memory		
WAIS/WISC Vocabulary	Vocabulary subtest from WAIS; WAIS-R; WAIS-III; WASI; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC; WISC-R; WISC-III; WISC-IV	Wechsler (1949), Wechsler (1955), Stinissen et al. (1970), Wechsler (1974b), Engvik et al. (1978), Wechsler (1981), Wechsler (1991), Wechsler (1997a), Wechsler (1999), Wechsler (2003)
WAIS/WISC Arithmetic	Arithmetic subtest from WAIS; WAIS-R; WAIS-III; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC-R	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Wechsler (1997a)
WAIS/WISC Digit Span Forward + Backward	Sum of Forward + Backward score from Digit Span subtest from WAIS; WAIS-R; WAIS-III; WAIS-IV; Dutch adaptation of WAIS; Norwegian adaptation of	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Wechsler (1991), Wechsler (1997a), Wechsler
Neuropsychological Test/Phenotype (organized by domain)*	**Test Summary Score(s)**	**Test Reference(s)**
WAIS/WISC Digit Span Forward	Forward score from Digit Span subtest from WAIS-III; WAIS-IV; WISC-III; WISC-IV	Wechsler (1991), Wechsler (1997a), Wechsler (2003), Wechsler (2008)
WAIS/WISC Digit Span Backward	Backward score from Digit Span subtest from WAIS-III; WAIS-IV; WISC-III; WISC-IV	Wechsler (1991), Wechsler (1997a), Wechsler (2003), Wechsler (2008)
WAIS/WISC Working Memory Index	Working Memory Index from WAIS-III; Norwegian adaptation of WAIS	Engvik et al. (1978), Wechsler (1997a)
WAIS/WISC Letter-Number Sequencing	Letter-Number Sequencing subtest from WAIS-III; WAIS-IV; WISC-IV	Wechsler (1997a), Wechsler (2003), Wechsler (2008)
SDRT	SDRT Accuracy	Glahn et al. (2003)
Spatial n-back	2-back Accuracy	Kirchner (1958), Friedman et al. (2008)
WMS Spatial Span	Spatial Span subtest from WMS-III	Wechsler (1997b)
Verbal Learning and Memory		
CVLT	Trials 1-5 Sum, Long Delay Free Recall, Recognition, and Semantic Clustering indices from the CVLT or CVLT-2	Delis et al. (1987), Delis et al. (2000)
Penn Word Memory	Accuracy score	Gur et al. (1993)
WMS Logical Memory IR	Logical Memory IR subtest from WMS; WMS-R; WMS-III	Wechsler (1945), Wechsler (1987), Wechsler (1997b)
WMS Logical Memory DR	Logical Memory DR subtest from WMS; WMS-R; WMS-III	Wechsler (1945), Wechsler (1987), Wechsler (1997b)
Non-Verbal Learning and Memory		
Penn Face Memory	IR; IR + DR total accuracy score	Gur et al. (1993)
VOLT	Accuracy	Glahn et al. (1997)
TPM	TPM Accuracy score	Thurstone (1938)
WMS Visual Reproduction IR	Visual Reproduction IR subtest from WMS; WMS-R; WMS-III	Wechsler (1945), Wechsler (1987), Wechsler (1997b)
WMS Visual Reproduction DR	Visual Reproduction DR subtest from WMS; WMS-R; WMS-III	Wechsler (1945), Wechsler (1987), Wechsler (1997b)
Verbal Ability		
DSB Synonyms	Synonyms total correct	Dureman et al. (1971)
Phonemic/Letter Fluency	Phonemic/Letter Fluency as measured by: "FAS" or "BHR" letters from D-KEFS; 8 letters representing three levels of difficulty; Letter "S", "R" or "T" letters; Letter naming fluency; Initial sound fluency; LPS word fluency	Horn (1962), Borkowski et al. (1967), Good et al. (1992), Kaminski et al. (1996), Kaminski et al. (1998), Fortuny et al. (2001), Delis et al. (2004), Hoekstra et al. (2009), Owens et al. (2011b)
Semantic Fluency	Semantic Fluency as measured by: CAP verbal fluency; CERAD Animal category; "Categories" fluency; D-KEFS Semantic fluency; MSCA semantic fluency; Animals or professions categories; Animals, fruits, vegetables; Animal fluency; "Four-legged animals"	Borkowski et al. (1967), McCarthy (1972), Morris et al. (1989), Cardon et al. (1992), Fortuny et al. (2001), McGue et al. (2001), Wilson et al. (2002), Delis et al. (2004), Hoekstra et al. (2009), Johnson et al. (2009), Owens et al. (2011b)
Semantic + Phonemic Fluency	BACS Semantic + Phonemic Fluency; Animal Naming + FAS-CFL from COWAT	Benton et al. (1989), Keefe et al. (2004), Keefe et al. (2008)
WAIS/WISC Vocabulary	Vocabulary subtest from WAIS; WAIS-R; WAIS-III; WASI; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC; WISC-R; WISC-III; WISC-IV	Wechsler (1949), Wechsler (1955), Stinissen et al. (1970), Wechsler (1974b), Engvik et al. (1978), Wechsler (1981), Wechsler (1991), Wechsler (1997a), Wechsler (1999), Wechsler (2003)
WAIS/WISC Information	Information subtest from WAIS; WAIS-R; WAIS-III; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC-R; WISC-IV	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Wechsler (1997a), Wechsler (2003)
WAIS/WISC Similarities	Similarities subtest from WAIS; WAIS-R; WAIS-III; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC-R; WISC-IV	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Wechsler (1997a), Wechsler (2003)
WAIS/WISC Comprehension	Comprehension subtest from WAIS; WAIS-III; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC-R	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1997a)
WAIS/WISC Verbal Comprehension Index	Verbal Comprehension index from WAIS-R; WAIS-III; WISC-R; WISC-III	Wechsler (1974a), Wechsler (1981), Wechsler (1991), Wechsler (1997a)
WRAT, Reading subtest	Reading subtest from WRAT-R; WRAT-III; WRAT-4	Jastak et al. (1984), Wilkinson (1993), Wilkinson et al. (2006)
Visuospatial Ability		
WAIS/WISC Block Design	Block Design subtest from WAIS; WAIS-R; WAIS-III; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC-R; WISC-IV	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Wechsler (1997a), Wechsler (2003)
WAIS/WISC Picture Completion	Picture Completion subtest from WAIS; WAIS-III; Dutch adaptation ofWAIS; Norwegian adaptation of WAIS; WISC-R	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1997a)

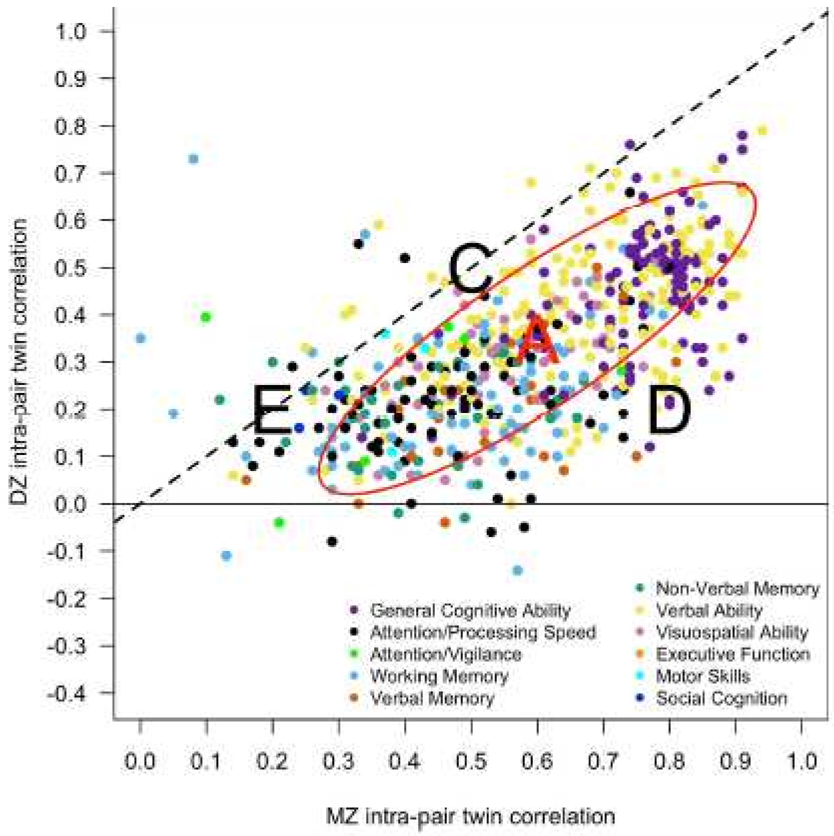
Neuropsychological Test/Phenotype (organized by domain)*	Test Summary Score(s)	Test Reference(s)
WAIS/WISC Picture Arrangement	Picture Arrangement subtest from WAIS; WAIS-III; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC-R	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1997a)
WAIS/WISC Object Assembly	Object Assembly subtest from WAIS; WAIS-III; Dutch adaptation of WAIS; Norwegian adaptation of WAIS; WISC-R	Wechsler (1955), Stinissen et al. (1970), Wechsler (1974a), Engvik et al. (1978), Wechsler (1997a)
WAIS/WISC Perceptual Organization Index	Perceptual Organization Index from WAIS-R; WAIS-III; Norwegian adaptation of WAIS; WISC-R; WISC-III	Wechsler (1974a), Engvik et al. (1978), Wechsler (1981), Wechsler (1991), Wechsler (1997a)
WAIS/WISC Matrix Reasoning	Matrix Reasoning subtest from WAIS-III; WASI; WISC-IV	Wechsler (1997a), Wechsler (1999), Wechsler (2003)
HFSC battery	Mental Rotation	DeFries et al. (1974)
JOLO	JOLO Accuracy	Benton et al. (1983)
ETS	Card Rotations	Ekstrom et al. (1976)
Executive Function		
PCET	Accuracy	Kurtz et al. (2004)
WCST, paper or computerized versions	Perseverative Responses; Perseverative Errors; Categories Completed; Trials to Complete 1st Category	Heaton et al. (1993), Heaton (2000)
Motor Skills		
CNB mouse practice task	Reaction time	Gur et al. (2001)
Purdue Pegboard	Pegboard Time Left + Right	Tiffin (1968)
Social Cognition		
Penn Emotion Recognition	Accuracy	Kohler et al. (2003)

* only includes 'primary' (individual) tests that were reported in at least 2 samples for calculation of meta-estimates of heritability

Abbreviations: AFQT = Armed Forces Qualification Test; BACS = Brief Assessment of Cognition in Schizophrenia; BMDI = Bayley Mental Developmental Index; BVRT = Benton Visual Retention Test; CANTAB = Cambridge Neuropsychological Test Automated Battery; CAP = Colorado Adoption Project; CAT = Cognitive Abilities Test; CERAD = Consortium to Establish a Registry for Alzheimer's Disease; CNB = Computerized Neurocognitive Battery; COWAT= Controlled Oral Word Association Test; CPT = Continuous Performance Test; CVLT = California Verbal Learning Test; D-KEFS = Delis-Kaplan Executive Function System; DR = Delayed Recall; DSB = Dureman-Sälde Battery; ETS = Educational Testing Service; FIQ = Full-scale Intelligence Quotient; GCA = General Cognitive Ability; GIT = Groninger Intelligence Test; HFSC = Hawaii Family Study of Cognition; IR = Immediate Recall; JOLO = Judgment of Line Orientation; LPS = Leistungsprüfsystem; MAB = Multidimensional Aptitude Battery; MAT = Metropolitan Achievement Test; MCDI = MacArthur-Bates Communicative Development Inventories; MMSE = Mini Mental State Exam; MSCA = McCarthy Scales of Children's Ability; ODRT = Object Delayed Response Test; PARCA = Parent Report of Children's Abilities; PCET = Penn Conditional Exclusion Test; PIQ = Performance Intelligence Quotient; PPVT = Peabody Picture Vocabulary Test; R = Revised; RAKIT = Revised Amsterdam Child Intelligence Test; RAPM = Raven's Advanced Progressive Matrices; RAVLT = Rey Auditory Verbal Learning Test; RCPM = Raven's Colored Progressive Matrices Test; RSPM = Raven's Standard Progressive Matrices; RT = Reaction Time; SBIS = Stanford-Binet Intelligence Scale; SCWT = Stroop Color-Word Test; SDMT = Symbol Digit Modalities Test; SDRT = Spatial Delayed-Response Task; TMT = Trail Making Test; TMT-A = Trail Making Test Part A; TMT-B = Trail Making Test Part B; TPM = Thurstone Picture Memory Test; VIQ = Verbal Intelligence Quotient; VOLT = Visual Object Learning Test; WAIS = Wechsler Adult Intelligence Scale; WASI = Wechsler Abbreviated Scale of Intelligence; WCST = Wisconsin Card Sorting Test; WISC = Wechsler Intelligence Scale for Children; WIT = Westrin Intelligence Test; WMS = Wechsler Memory Scale; WRAT = Wide Range Achievement Test



Supplementary Figure 1 – Flow Diagram of Literature Search, Inclusion, and Exclusion

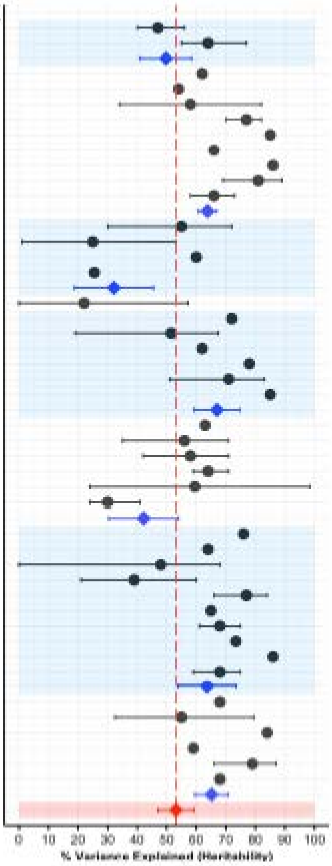


Supplementary Figure 2 – MZ versus DZ twin correlations for neuropsychological variables grouped by cognitive domain

Reported monozygotic (MZ) twin correlations (x-axis) from non-psychiatric twin studies are plotted against the corresponding dizygotic (DZ) twin correlations (y-axis) for those same neuropsychological variables. Each dot represents the correlation estimate for a particular neuropsychological variable from one study. The locations of the correlations on the plot indicate the magnitude of additive (A) or dominance (D) genetic influences and common (C) or unique (E) environmental influences, as well as the reliability of the phenotype. The diagonal indicates equality of MZ and DZ correlation. Neuropsychological variables above the diagonal have no evidence for additive genetic variance, while those below the diagonal have some degree of genetic variance ($r_{MZ} > r_{DZ}$). Variables in ellipse "A" have moderate to high additive genetic influences. Variables in the lower right corner ($r_{MZ} > 2(r_{DZ})$) have some degree of dominant genetic effects ("D"). Variables close to the diagonal ($r_{MZ} < 2(r_{DZ})$) have some degree of common environmental influences ("C"). Variables in the bottom left corner (low r_{MZ} and low r_{DZ}) are largely influenced by unique environmental effects and/or measurement error ("E"). Variables having MZ or DZ twin correlations near or below zero are unreliable. Data included in this plot were obtained from the studies listed in Supplementary Table 5.

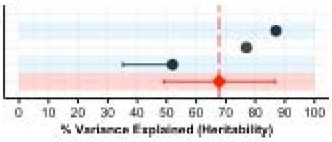
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Grant, 2010	VETR	6,406	AFQT
Vasilopoulos, 2012a	VETSA	1,238	AFQT
Meta-estimate	**2 Studies**	**7,644**	**AFQT**
Keller, 2013	CLTS / CTS	8,072	Full-scale IQ
Neubauer, 2000	GOSAT	600	Full-scale IQ
Silventoinen, 2012	MTFS	1,252	Full-scale IQ
Goldberg, 2013	MTS / UOB	526	Full-scale IQ
Tambs, 1984	OTSN	160	Full-scale IQ
Malykh, 2005	RSTR	160	Full-scale IQ
Bartfai, 1991	SATSA	66	Full-scale IQ
Brouwer, 2014a	UMCU / NTR	132	Full-scale IQ
Haworth, 2010	WRRP / TEDS	6,150	Full-scale IQ
Meta-estimate	**9 Studies**	**17,120**	**Full-scale IQ**
Giubilei, 2008	ITR	186	MMSE
McGue, 2007	LSADT	2,224	MMSE
Swan, 1990	NHLBI	534	MMSE
Pedersen, 1996	SATSA	498	MMSE
Meta-estimate	**4 Studies**	**3,442**	**MMSE**
Xu, 2015	QTR	768	MoCA
Luciano, 2005	MAPS / NTR	3,012	Performance IQ
Silventoinen, 2012	MTFS	1,252	Performance IQ
Tambs, 1984	OTSN	160	Performance IQ
Malykh, 2005	RSTR	160	Performance IQ
Brouwer, 2014a	UMCU / NTR	132	Performance IQ
Baker, 1991	UWO	164	Performance IQ
Meta-estimate	**6 Studies**	**4,880**	**Performance IQ**
Neubauer, 2000	GOSAT	600	Raven's Progressive Matrices
Giubilei, 2008	ITR	186	Raven's Progressive Matrices
Johnson, 2007b	MISTRA	252	Raven's Progressive Matrices
Rijsdijk, 2002	NTR	388	Raven's Progressive Matrices
Mosing, 2014	STR	5,138	Raven's Progressive Matrices
Rommel, 2015	TEDS	9,542	Raven's Progressive Matrices
Meta-estimate	**6 Studies**	**16,104**	**Raven's Progressive Matrices**
Friedman, 2008	CLTS	1,164	Spearman's g
Neubauer, 2000	GOSAT	600	Spearman's g
Steves, 2013	HATS	488	Spearman's g
McGue, 2007	LSADT	2,224	Spearman's g
Johnson, 2007b	MISTRA	252	Spearman's g
Sundet, 1988	NAF	634	Spearman's g
Swagerman, 2016	NTR	1,632	Spearman's g
Lee, 2012b	OATS	436	Spearman's g
Finkel, 2004	SATSA	1,280	Spearman's g
Reed, 2006	STR	872	Spearman's g
Meta-estimate	**10 Studies**	**9,692**	**Spearman's g**
Luciano, 2005	MAPS / NTR	3,012	Verbal IQ
Silventoinen, 2012	MTFS	1,252	Verbal IQ
Tambs, 1984	OTSN	160	Verbal IQ
Malykh, 2005	RSTR	160	Verbal IQ
Brouwer, 2014a	UMCU / NTR	132	Verbal IQ
Baker, 1991	UWO	164	Verbal IQ
Meta-estimate	**6 Studies**	**4,880**	**Verbal IQ**
Meta-estimate	***25 Studies***	***47,890***	***General Cognitive Ability Domain***



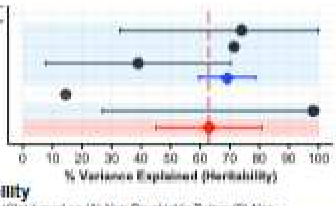
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Rowe, 1999b	NLSY	4,460	AFQT
Glahn, 2013	GOBS	1,129	Full-scale IQ
Luciano, 2010	SFHS	6,118	Spearman's g
Meta-estimate	***3 Studies***	***11,707***	***General Cognitive Ability Domain***



C. Schizophrenia Families

Reference	Cohort	N	Measure
Husted, 2009	CAMH	83	Full-scale IQ
Glahn, 2014	GOBS	1,606	Full-scale IQ
Aukes, 2009	UMCU	133	Full-scale IQ
Meta-estimate	**3 Studies**	**1,822**	**Full-scale IQ**
Glahn, 2007	GOBS / CVCR	269	Raven's Progressive Matrices
Bertisch, 2010	NAMI	48	Spearman's g
Meta-estimate	***5 Studies***	***2,139***	***General Cognitive Ability Domain***



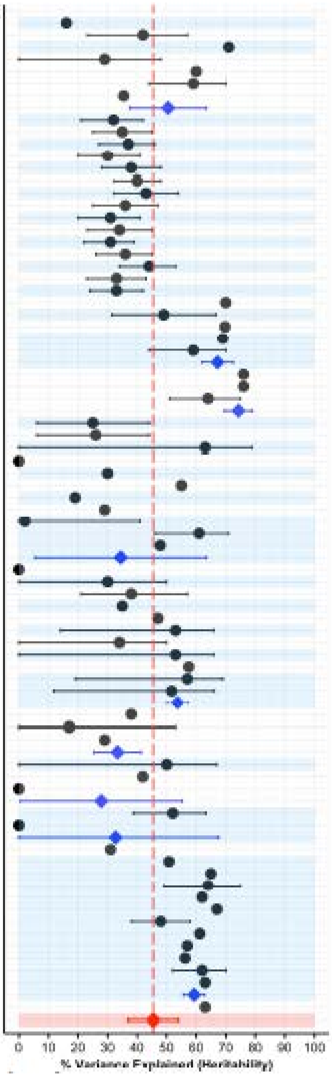
Supplementary Figure 3 – Heritability of General Cognitive Ability

Forest plot of individual study and meta heritability estimates and 95% confidence intervals (CIs) based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families; and (C) Schizophrenia Families. IQ measures were obtained from the WAIS or WISC, except for Wainwright et al. (2005b) and Luciano et al. (2005). They used the Multidimensional Aptitude Battery, which correlates very highly with the WAIS. The CI is based on the variance across studies in the variance component estimates. For studies that reported the standard error (SE), the CI was calculated [variance component estimate ± (1.96 × SE)]. CIs are not shown for studies that did not report CI or SE. For (Pedersen et al. 1996, Anokhin et al. 2010, Silventoinen et al. 2012), the average variance component estimates for males and females were included in the meta-analysis. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font). For plotting purposes, the cohort name was truncated for Keller et al. (CLTS / CTS / CFAM / MAPS), and Haworth et al. (WRRP / TEDS / MCTFR / CLTS / CTS / CLDRC / MAPS / NTR).

Abbreviations: AFQT = Armed Forces Qualification Test; MMSE = Mini Mental State Examination; MoCA = Montreal Cognitive Assessment

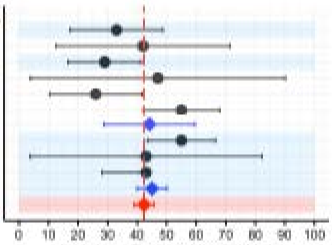
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Fan, 2001	PUC	104	Attentional Network Test RT
Johnson, 2007b	MISTRA	252	CAB Perceptual Speed
Bartfai, 1991	SATSA	66	Choice RT Accuracy
Steves, 2013	HATS	488	Choice RT Mean RT
Wainwright, 2008	MAPS	1,452	Choice RT Mean RT
Rijsdijk, 1998	NTR	376	Choice RT Mean RT
Lee, 2012b	OATS	436	Choice RT Mean RT
Meta-estimate	**4 Studies**	**2,752**	**Choice RT Mean RT**
Swagerman, 2016	NTR	1,632	CNB Age Differentiation RT
Swagerman, 2016	NTR	1,632	CNB Emotion Intensity Discrimination RT
Swagerman, 2016	NTR	1,632	CNB Emotion Recognition RT
Swagerman, 2016	NTR	1,632	CNB JOLO RT
Swagerman, 2016	NTR	1,632	CNB PCET RT
Swagerman, 2016	NTR	1,632	CNB Penn CPT RT
Swagerman, 2016	NTR	1,632	CNB Penn Face Memory DR RT
Swagerman, 2016	NTR	1,632	CNB Penn Face Memory IR RT
Swagerman, 2016	NTR	1,632	CNB Penn Letter n-back RT
Swagerman, 2016	NTR	1,632	CNB Penn Matrix Reasoning RT
Swagerman, 2016	NTR	1,632	CNB Penn Verbal Reasoning RT
Swagerman, 2016	NTR	1,632	CNB Penn Word Memory DR RT
Swagerman, 2016	NTR	1,632	CNB Penn Word Memory IR RT
Swagerman, 2016	NTR	1,632	CNB VOLT DR RT
Swagerman, 2016	NTR	1,632	CNB VOLT IR RT
Friedman, 2008	CLTS	1,164	Colorado Perceptual Speed
Kochunov, 2016	MTR	726	Comparison Processing Speed Test
Finkel, 2000a	SATSA	584	DSB Figure Identification
Friedman, 2008	CLTS	1,164	ETS Hidden Patterns
Johnson, 2007b	MISTRA	252	ETS Hidden Patterns
Meta-estimate	**2 Studies**	**1,416**	**ETS Hidden Patterns**
Friedman, 2008	CLTS	1,164	ETS Identical Pictures
Rose, 1981	KMTP-IUTP	368	ETS Identical Pictures
Johnson, 2007b	MISTRA	252	ETS Identical Pictures
Meta-estimate	**3 Studies**	**1,784**	**ETS Identical Pictures**
Posthuma, 2002b	NTR	472	Flanker DT Congruent Stimuli
Johnson, 2007b	MISTRA	252	HFSC Lines and Dots
Nandagopal, 2010	FSTR	76	Sentence Picture Verification RT
Singer, 2006	TwinsUK	556	Simple RT + Choice RT
Finkel, 2014	SATSA	160	Simple RT + Choice RT Mean DT
Finkel, 2014	SATSA	160	Simple RT + Choice RT Mean MT
Finkel, 2014	SATSA	160	Simple RT + Choice RT Range DT
Finkel, 2014	SATSA	160	Simple RT + Choice RT Range MT
Steves, 2013	HATS	488	Simple RT Mean RT
Rijsdijk, 1998	NTR	376	Simple RT Mean RT
Lee, 2012b	OATS	436	Simple RT Mean RT
Meta-estimate	**3 Studies**	**1,300**	**Simple RT Mean RT**
Neubauer, 2000	GOSAT	600	SMST 1-digit RT
Vinkhuyzen, 2010	NTR	696	SMST 1-digit RT Non-Target Trials
Vinkhuyzen, 2010	NTR	696	SMST 1-digit RT Target Trials
Neubauer, 2000	GOSAT	600	SMST 3-digit RT
Neubauer, 2000	GOSAT	600	SMST 5-digit RT
Blokland, 2011	MAPS	282	Spatial 0-back RT
Blokland, 2011	MAPS	282	Spatial 2-back RT
Taylor, 2007	FSTR	218	Stroop Color Naming
Lee, 2012b	OATS	436	Stroop Color Naming+Word Reading
Taylor, 2007	FSTR	218	Stroop Color-Word
Lessov-S., 2007	NHLBI	370	Stroop Color-Word
Meta-estimate	**2 Studies**	**588**	**Stroop Color-Word**
Friedman, 2008	CLTS	1,164	Stroop Interference
Taylor, 2007	FSTR	218	Stroop Interference
Lee, 2012a	OATS	430	Stroop Interference
Meta-estimate	**3 Studies**	**1,812**	**Stroop Interference**
Taylor, 2007	FSTR	218	Stroop Word Reading
Lee, 2012b	OATS	436	Trail Making Test A Time
Hall, 1996	UPTS	220	Trail Making Test A Time
Meta-estimate	**2 Studies**	**656**	**Trail Making Test A Time**
Lessov-S., 2007	NHLBI	370	Trail Making Test B Time
Hall, 1996	UPTS	220	Trail Making Test B Time
Meta-estimate	**2 Studies**	**590**	**Trail Making Test B Time**
Lee, 2012a	OATS	430	Trail Making Test B-to-A Ratio
Friedman, 2008	CLTS	1,164	WAIS Digit Symbol Coding
Wainwright, 2004	MAPS	1,000	WAIS Digit Symbol Coding
Johnson, 2007b	MISTRA	252	WAIS Digit Symbol Coding
Finkel, 1995b	MTSADA	382	WAIS Digit Symbol Coding
Swan, 1990	NHLBI	534	WAIS Digit Symbol Coding
Rijsdijk, 2002	NTR	388	WAIS Digit Symbol Coding
Lee, 2012b	OATS	436	WAIS Digit Symbol Coding
Tambs, 1984	OTSN	160	WAIS Digit Symbol Coding
Finkel, 2000a	SATSA	584	WAIS Digit Symbol Coding
Read, 2006	STR	960	WAIS Digit Symbol Coding
Hall, 1996	UPTS	220	WAIS Digit Symbol Coding
Meta-estimate	**11 Studies**	**6,080**	**WAIS Digit Symbol Coding**
Posthuma, 2003	NTR	844	WAIS Processing Speed Index
Meta-estimate	***18 Studies***	***9,339***	***Attention/Processing Speed Domain***



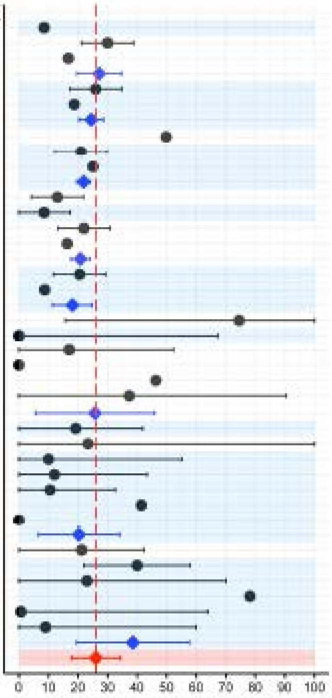
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Sleegers, 2007	ERF	780	Stroop Color-Word
Greenwood, 2011	CVCR	253	Trail Making Test-A + B Time
Knowles, 2014	GOBS	1,269	Trail Making Test-A Time
Chen, 2009	CCNMD	157	Trail Making Test-B Time
Sleegers, 2007	ERF	780	Trail Making Test-B Time
Knowles, 2014	GOBS	1,269	Trail Making Test-B Time
Meta-estimate	**3 Studies**	**2,206**	**Trail Making Test-B Time**
Knowles, 2014	GOBS	1,269	WAIS Digit Symbol Coding
Kochunov, 2016	OOA	145	WAIS Digit Symbol Coding
Luciano, 2010	SFHS	6,118	WAIS Digit Symbol Coding
Meta-estimate	**3 Studies**	**7,532**	**WAIS Digit Symbol Coding**
Meta-estimate	***6 Studies***	***8,722***	***Attention/Processing Speed Domain***



C. Schizophrenia Families

Reference	Cohort	N	Measure
Gur, 2007	PMFS	377	CNB Emotion Intensity Discrimination RT
Calkins, 2010	PAARTNERS	1,538	CNB JOLO RT
Gur, 2007	PMFS	419	CNB JOLO RT
Meta-estimate	**2 Studies**	**1,957**	**CNB JOLO RT**
Calkins, 2010	PAARTNERS	1,538	CNB PCET RT
Gur, 2007	PMFS	409	CNB PCET RT
Meta-estimate	**2 Studies**	**1,947**	**CNB PCET RT**
Gur, 2007	PMFS	419	CNB Penn CPT RT
Calkins, 2010	PAARTNERS	1,539	CNB Penn Face Memory RT
Gur, 2007	PMFS	430	CNB Penn Face Memory RT
Meta-estimate	**2 Studies**	**1,968**	**CNB Penn Face Memory RT**
Calkins, 2010	PAARTNERS	1,538	CNB Penn Letter n-back RT
Calkins, 2010	PAARTNERS	1,538	CNB Penn Verbal Reasoning RT
Calkins, 2010	PAARTNERS	1,538	CNB Penn Word Memory RT
Gur, 2007	PMFS	412	CNB Penn Word Memory RT
Meta-estimate	**2 Studies**	**1,950**	**CNB Penn Word Memory RT**
Calkins, 2010	PAARTNERS	1,538	CNB VOLT RT
Gur, 2007	PMFS	397	CNB VOLT RT
Meta-estimate	**2 Studies**	**1,935**	**CNB VOLT RT**
Bertisch, 2010	NAMI	81	Stroop Color-Word
Bertisch, 2010	NAMI	59	Trail Making Test-A Percentile
Husted, 2009	CAMH	82	Trail Making Test-A Time
Mendoza-Q., 2009	CMHHC	225	Trail Making Test-A Time
Glahn, 2007	GOBS / CVCR	269	Trail Making Test-A Time
Bertisch, 2010	NAMI	85	Trail Making Test-A Time
Meta-estimate	**4 Studies**	**661**	**Trail Making Test-A Time**
Mendoza-Q., 2009	CMHHC	225	Trail Making Test-B - A Difference
Bertisch, 2010	NAMI	53	Trail Making Test-B Percentile
Husted, 2009	CAMH	82	Trail Making Test-B Time
Chen, 2009	CCNMD	121	Trail Making Test-B Time
Mendoza-Q., 2009	CMHHC	225	Trail Making Test-B Time
Glahn, 2007	GOBS / CVCR	269	Trail Making Test-B Time
Bertisch, 2010	NAMI	81	Trail Making Test-B Time
Meta-estimate	**5 Studies**	**718**	**Trail Making Test-B Time**
Mendoza-Q., 2009	CMHHC	225	Trail Making Test-B-to-A Ratio
Hill, 2013	B-SNIP	971	WAIS Digit Symbol Coding
Husted, 2009	CAMH	80	WAIS Digit Symbol Coding
Glahn, 2007	GOBS / CVCR	269	WAIS Digit Symbol Coding
Bertisch, 2010	NAMI	84	WAIS Digit Symbol Coding
Tuulio-H., 2002	NPHIP	259	WAIS Digit Symbol Coding
Meta-estimate	**5 Studies**	**1,663**	**WAIS Digit Symbol Coding**
Meta-estimate	***9 Studies***	***3,947***	***Attention/Processing Speed Domain***

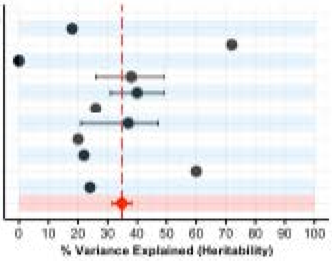


Supplementary Figure 4 – Heritability of Attention/Processing Speed
Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability, for neuropsychological tests that fall within the Attention/Processing Speed domain, based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families; and (C) Schizophrenia Families/Pedigrees.

estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font). For plotting purposes, the cohort name was truncated for Glahn et al. (GOBS / CVCR / MCM).
Abbreviations: ANT = Amsterdam Neuropsychological Tasks; CNB = Computerized Neurocognitive Battery; CPT = Continuous Performance Test; DSB = Dureman-Sälde Battery; DT = Decision Time; ETS = Education Testing Service; HFSC = Hawaii Family Study of Cognition; JOLO = Judgment of Line Orientation; MT = Movement Time; PCET = Penn Conditional Exclusion Test; RT = Reaction Time; SMST = Sternberg Memory Scanning Task; TMT-A = Trail Making Test Part A; TMT-B = Trail Making Test Part B; VOLT = Visual Object Learning Test.

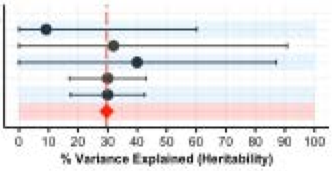
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Fan, 2001	PUC	104	Attentional Network Test Alerting
Fan, 2001	PUC	104	Attentional Network Test Conflict
Fan, 2001	PUC	104	Attentional Network Test Orienting
Swagerman, 2016	NTR	1,632	CNB Penn CPT Hits
Kremen, 2011b	VETSA	1,228	CPT-AX d-prime
Kremen, 2011b	VETSA	1,228	CPT-AX False Alarms
Kremen, 2011b	VETSA	1,228	CPT-AX Non-context Errors RT
Kremen, 2011b	VETSA	1,228	CPT-AX Omission Errors
Neubauer, 2000	GOSAT	600	PLMT RT Difference NI - PI
Neubauer, 2000	GOSAT	600	PLMT RT Name Identity
Neubauer, 2000	GOSAT	600	PLMT RT Physical Identity
Meta-estimate	***4 Studies***	***3,564***	***Attention/Vigilance Domain***



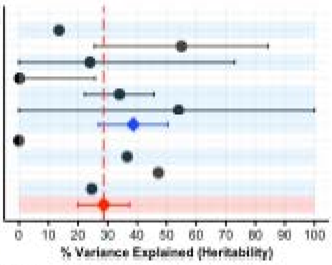
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Chen, 2009	CCNMD	157	CPT-AX Accuracy
Chen, 2009	CCNMD	157	CPT-Degraded Stimulus Accuracy
Chen, 2009	CCNMD	157	CPT-IP 4-item d-prime
Knowles, 2014	GOBS	1,269	CPT-IP False Alarms
Knowles, 2014	GOBS	1,269	CPT-IP Hits
Meta-estimate	***2 Studies***	***1,426***	***Attention/Vigilance Domain***



C. Schizophrenia Families

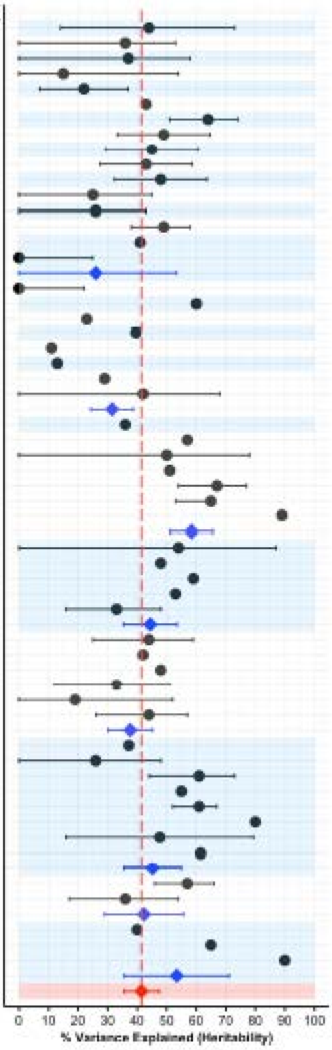
Reference	Cohort	N	Measure
Gur, 2007	PMFS	419	CNB Penn CPT Hits
Chen, 1998	MPSS	270	CPT-19 d-prime
Chen, 2009	CCNMD	121	CPT-AX Accuracy
Chen, 2009	CCNMD	121	CPT-Degraded Stimulus Accuracy
Greenwood, 2013	COGS	881	CPT-Degraded Stimulus d-prime
Chen, 1998	MPSS	270	CPT-Degraded Stimulus d-prime
Meta-estimate	**2 Studies**	**1,151**	**CPT-Degraded Stimulus d-prime**
Chen, 2009	CCNMD	121	CPT-IP 4-item d-prime
Glahn, 2007	GOBS / CVCR	268	CPT-IP a-prime
Glahn, 2007	GOBS / CVCR	268	CPT-IP beta
Glahn, 2014	GOBS	1,606	CPT-IP Hits
Meta-estimate	***6 Studies***	***3,566***	***Attention/Vigilance Domain***



Supplementary Figure 5 – Heritability of Attention/Vigilance
Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability for Attention/Vigilance, based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families, and (C) Schizophrenia Families/Pedigrees.
For Non-Psychiatric twins and Non-Psychiatric families/pedigrees, no individual test was studied in more than one cohort, so only a domain meta-estimate could be calculated. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font). For plotting purposes, the cohort name was truncated for Glahn et al. (GOBS / CVCR / MCM).
Abbreviations: ANT = Amsterdam Neuropsychological Tasks (De Sonneville, 1999); CNB = Computerized Neurocognitive Battery; CPT-19 = 1-9 Continuous Performance Test; CPT-AX = A-X Continuous Performance Test; CPT-IP = Continuous Performance Test – Identical Pairs; PLMT = Posner's Letter-Matching Task; RT = Reaction Time.

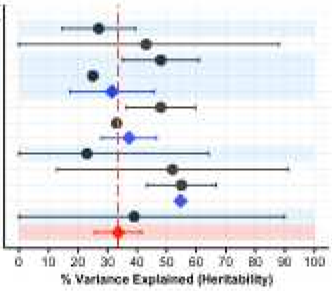
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Vuoksimaa, 2014	VETSA	454	AFQT Arithmetic
Steves, 2013	HATS	488	CANTAB Delayed Matching to Sample
Steves, 2013	HATS	488	CANTAB Spatial Span
Steves, 2013	HATS	488	CANTAB Spatial Working Memory Errors
Swagerman, 2016	NTR	1,632	CNB Penn Letter n-back Accuracy
van Leeuwen, 2009b	NTR	558	Corsi Block Tapping
Johnson, 2007b	MISTRA	252	ETS Subtraction & Multiplication
Ando, 2001	KTP	296	Kyodai NX15 Spatial WM Executive
Ando, 2001	KTP	290	Kyodai NX15 Spatial WM Storage
Ando, 2001	KTP	296	Kyodai NX15 Verbal WM Executive
Ando, 2001	KTP	296	Kyodai NX15 Verbal WM Storage
Kremen, 2011a	VETR	632	ODRT Accuracy
Kremen, 2011a	VETR	632	ODRT Errors
Kremen, 2007b	VETR	678	Reading span
Hansell, 2005	MAPS	1,098	SDRT Accuracy
Kremen, 2011a	VETR	632	SDRT Accuracy
Meta-estimate	**2 Studies**	**1,730**	**SDRT Accuracy**
Kremen, 2011a	VETR	632	SDRT Errors
Luciano, 2004	MAPS	1,086	SDRT Initiation Time
Luciano, 2004	MAPS	1,086	SDRT MT
Luciano, 2004	MAPS	1,086	SDRT Winnings
Neubauer, 2000	GOSAT	600	SMST increase RT with set size
Neubauer, 2000	GOSAT	600	SMST Intercept
Friedman, 2008	CLTS	1,164	Spatial 2-back Accuracy
Blokland, 2011	MAPS	282	Spatial 2-back Accuracy
Meta-estimate	**2 Studies**	**1,446**	**Spatial 2-back Accuracy**
van Leeuwen, 2009b	NTR	558	Spatial 3-back Accuracy
Friedman, 2008	CLTS	1,164	WAIS Arithmetic
Pinel, 2013	INSERM	64	WAIS Arithmetic
Wainwright, 2004	MAPS	1,000	WAIS Arithmetic
Johnson, 2007b	MISTRA	252	WAIS Arithmetic
Rijsdijk, 2002	NTR	388	WAIS Arithmetic
Tambs, 1984	OTSN	160	WAIS Arithmetic
Meta-estimate	**6 Studies**	**3,028**	**WAIS Arithmetic**
Nandagopal, 2010	FSTR	78	WAIS Digit Span Backward
van Leeuwen, 2009b	NTR	558	WAIS Digit Span Backward
Lee, 2012a	OATS	430	WAIS Digit Span Backward
Finkel, 2000a	SATSA	584	WAIS Digit Span Backward
Panizzon, 2014	VETSA	1,222	WAIS Digit Span Backward
Meta-estimate	**5 Studies**	**2,870**	**WAIS Digit Span Backward**
Johnson, 2007b	MISTRA	252	WAIS Digit Span Forward
van Leeuwen, 2009b	NTR	558	WAIS Digit Span Forward
Finkel, 2000a	SATSA	584	WAIS Digit Span Forward
Read, 2006	STR	1,102	WAIS Digit Span Forward
Kremen, 2007b	VETR	678	WAIS Digit Span Forward
Panizzon, 2014	VETSA	1,222	WAIS Digit Span Forward
Meta-estimate	**6 Studies**	**4,396**	**WAIS Digit Span Forward**
Friedman, 2008	CLTS	1,164	WAIS Digit Span Forward + Backward
McGue, 2001	LSADT	806	WAIS Digit Span Forward + Backward
Johnson, 2007b	MISTRA	252	WAIS Digit Span Forward + Backward
Finkel, 1995b	MTSADA	382	WAIS Digit Span Forward + Backward
Rijsdijk, 2002	NTR	388	WAIS Digit Span Forward + Backward
Tambs, 1984	OTSN	160	WAIS Digit Span Forward + Backward
Xu, 2015	QTR	768	WAIS Digit Span Forward + Backward
Hall, 1996	UPTS	220	WAIS Digit Span Forward + Backward
Meta-estimate	**8 Studies**	**4,148**	**WAIS Digit Span Forward + Backward**
Goldberg, 2013	MTS / UOB	528	WAIS Letter-Number Sequencing
Panizzon, 2014	VETSA	1,222	WAIS Letter-Number Sequencing
Meta-estimate	**2 Studies**	**1,750**	**WAIS Letter-Number Sequencing**
Friedman, 2008	CLTS	1,164	WAIS Working Memory Index
Posthuma, 2003	NTR	844	WAIS Working Memory Index
Tambs, 1984	OTSN	160	WAIS Working Memory Index
Meta-estimate	**3 Studies**	**2,168**	**WAIS Working Memory Index**
Meta-estimate	***20 Studies***	***11,223***	***Working Memory Domain***



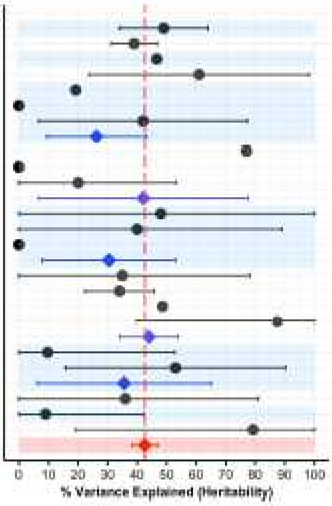
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Knowles, 2014	GOBS	1,269	SDRT Accuracy
Chen, 2009	CCNMD	157	Spatial 2-back Accuracy
Knowles, 2014	GOBS	1,269	WAIS Digit Span Backward
Matteini, 2010	LLFS	3,224	WAIS Digit Span Backward
Meta-estimate	**2 Studies**	**4,493**	**WAIS Digit Span Backward**
Knowles, 2014	GOBS	1,269	WAIS Digit Span Forward
Matteini, 2010	LLFS	3,224	WAIS Digit Span Forward
Meta-estimate	**2 Studies**	**4,493**	**WAIS Digit Span Forward**
Chen, 2009	CCNMD	157	WAIS Digit Span Forward + Backward
Chen, 2009	CCNMD	157	WAIS Letter-Number Sequencing
Knowles, 2014	GOBS	1,269	WAIS Letter-Number Sequencing
Meta-estimate	**2 Studies**	**1,426**	**WAIS Letter-Number Sequencing**
Chen, 2009	CCNMD	157	WMS Spatial Span
Meta-estimate	***3 Studies***	***4,650***	***Working Memory Domain***



C. Schizophrenia Families

Reference	Cohort	N	Measure
Hill, 2013	B-SNIP	971	BACS Digit Sequencing
Wiener, 2013	PAARTNERS	1,606	CNB Penn Letter n-back Accuracy
Glahn, 2007	GOBS / CVCR	268	SDRT Accuracy
Chen, 2009	CCNMD	121	Spatial 2-back Accuracy
Glahn, 2007	GOBS / CVCR	269	WAIS Digit Span Backward
Bertisch, 2010	NAMI	85	WAIS Digit Span Backward
Tuulio-H., 2002	NPHIF	262	WAIS Digit Span Backward
Meta-estimate	**3 Studies**	**616**	**WAIS Digit Span Backward**
Glahn, 2007	GOBS / CVCR	269	WAIS Digit Span Forward
Bertisch, 2010	NAMI	85	WAIS Digit Span Forward
Tuulio-H., 2002	NPHIF	262	WAIS Digit Span Forward
Meta-estimate	**3 Studies**	**616**	**WAIS Digit Span Forward**
Husted, 2009	CAMH	82	WAIS Digit Span Forward + Backward
Chen, 2009	CCNMD	121	WAIS Digit Span Forward + Backward
Bertisch, 2010	NAMI	85	WAIS Digit Span Forward + Backward
Meta-estimate	**3 Studies**	**288**	**WAIS Digit Span Forward + Backward**
Chen, 2009	CCNMD	121	WAIS Letter-Number Sequencing
Greenwood, 2013	COGS	951	WAIS Letter-Number Sequencing
Glahn, 2014	GOBS	1,606	WAIS Letter-Number Sequencing
Bertisch, 2010	NAMI	73	WAIS Letter-Number Sequencing
Meta-estimate	**4 Studies**	**2,750**	**WAIS Letter-Number Sequencing**
Chen, 2009	CCNMD	121	WMS Spatial Span
Aukes, 2009	UMCU	180	WMS Spatial Span
Meta-estimate	**2 Studies**	**301**	**WMS Spatial Span**
Tuulio-H., 2002	NPHIF	261	WMS Visual Span Backward
Tuulio-H., 2002	NPHIF	261	WMS Visual Span Forward
Bertisch, 2010	NAMI	85	WRAT Arithmetic
Meta-estimate	***10 Studies***	***6,121***	***Working Memory Domain***



Supplementary Figure 6 – Heritability of Working Memory

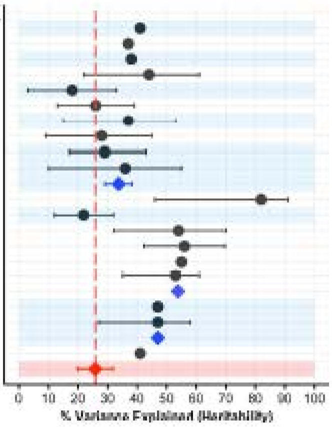
Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability for Working Memory, based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families, and (C) Schizophrenia Families/Pedigrees.

Digit Span data were obtained from the WAIS for all studies except Nandagopal et al. (2010) who used Educational Testing Service (ETS) Digit Span. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font). For plotting purposes, the cohort name was truncated for Glahn et al. (GOBS / CVCR / MCM).

<u>Abbreviations</u>: CAB = Comprehensive Ability Battery; CNB = Computerized Neurocognitive Battery; SDRT = Spatial Delayed Response Task; SMST = Sternberg Memory Scanning Task; RT = Reaction Time; WRAT = Wide Range Achievement Test.

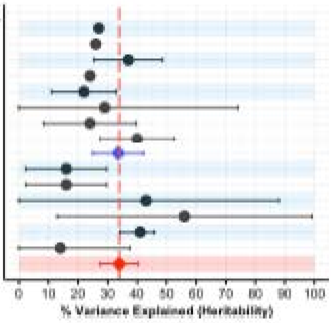
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Volk, 2006	MOAFTS	190	15-Word List Learning Free Recall
Volk, 2006	MOAFTS	190	30-Word List Learning Cued Recall Ctgy
Volk, 2006	MOAFTS	190	30-Word List Learning Free Recall Ctgy
Johnson, 2007b	MISTRA	252	CAB Meaningful Memory
Swagerman, 2016	NTR	1,632	CNB Penn Word Memory DR Accuracy
Swagerman, 2016	NTR	1,632	CNB Penn Word Memory IR Accuracy
Kremen, 2014	VETSA	1,228	CVLT Long Delay Free Recall
Kremen, 2014	VETSA	1,228	CVLT Short Delay Free Recall
Hoekstra, 2009	NTR	556	CVLT Trials 1-5 Sum
Panizzon, 2011	VETSA	1,148	CVLT Trials 1-5 Sum
Meta-estimate	**2 Studies**	**1,704**	**CVLT Trials 1-5 Sum**
Nandagopal, 2010	FSTR	76	ETS Paired Associate Memory DR
McArdle, 2009	NASTR	12,880	TICS Word List Learning IR + DR
Giubilei, 2008	ITR	186	WMS Logical Memory DR
Finkel, 1993	MTSADA	300	WMS Logical Memory DR
Hall, 1996	UPTS	220	WMS Logical Memory DR
Kremen, 2014	VETSA	1,228	WMS Logical Memory DR
Meta-estimate	**4 Studies**	**1,934**	**WMS Logical Memory DR**
Finkel, 1998a	MTSADA	682	WMS Logical Memory IR
Kremen, 2014	VETSA	1,228	WMS Logical Memory IR
Meta-estimate	**2 Studies**	**1,910**	**WMS Logical Memory IR**
Finkel, 1998a	MTSADA	682	Word Recall from Line Drawings
Meta-estimate	***9 Studies***	***16,845***	***Verbal Memory Domain***



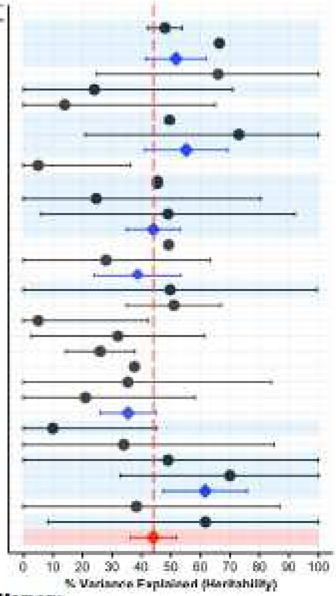
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Matteini, 2010	LLFS	3,224	CERAD Word List Memory DR
Matteini, 2010	LLFS	3,224	CERAD Word List Memory IR
Knowles, 2014	GOBS	1,269	CVLT Long Delay Free Recall
Glahn, 2013	GOBS	1,129	CVLT Recognition
Knowles, 2014	GOBS	1,269	CVLT Semantic Clustering
Chen, 2009	CCNMD	157	CVLT Trials 1-5 Sum
Sleegers, 2007	ERF	780	CVLT Trials 1-5 Sum
Knowles, 2014	GOBS	1,269	CVLT Trials 1-5 Sum
Meta-estimate	**3 Studies**	**2,206**	**CVLT Trials 1-5 Sum**
Sleegers, 2007	ERF	780	RAVLT DR
Sleegers, 2007	ERF	780	RAVLT Recognition
Chen, 2009	CCNMD	157	WMS Family Pictures IR
Chen, 2009	CCNMD	157	WMS Logical Memory IR
Luciano, 2010	SFHS	6,118	WMS Logical Memory IR + DR
Greenwood, 2011	CVCR	253	Word List Learning Recognition
Meta-estimate	***6 Studies***	***11,766***	***Verbal Memory Domain***



C. Schizophrenia Families

Reference	Cohort	N	Measure
Wiener, 2013	PAARTNERS	1,606	CNB Penn Word Memory IR + DR
Gur, 2007	PMFS	412	CNB Penn Word Memory IR + DR
Meta-estimate	**2 Studies**	**2,018**	**CNB Penn Word Memory IR + DR**
Tuulio-H., 2002	NPHIF	264	CVLT Intrusions
Tuulio-H., 2002	NPHIF	264	CVLT Learning Strategy Primacy
Tuulio-H., 2002	NPHIF	264	CVLT Learning Strategy Recency
Glahn, 2007	GOBS / CVCR	269	CVLT Long Delay Free Recall
Bertisch, 2010	NAMI	86	CVLT Long Delay Free Recall
Meta-estimate	**2 Studies**	**355**	**CVLT Long Delay Free Recall**
Tuulio-H., 2002	NPHIF	264	CVLT Perseverations
Glahn, 2007	GOBS / CVCR	269	CVLT Recognition
Bertisch, 2010	NAMI	86	CVLT Recognition
Tuulio-H., 2002	NPHIF	264	CVLT Recognition
Meta-estimate	**3 Studies**	**619**	**CVLT Recognition**
Glahn, 2007	GOBS / CVCR	269	CVLT Semantic Clustering
Tuulio-H., 2002	NPHIF	264	CVLT Semantic Clustering
Meta-estimate	**2 Studies**	**533**	**CVLT Semantic Clustering**
Bertisch, 2010	NAMI	86	CVLT Short Delay Free Recall
Hill, 2013	B-SNIP	671	CVLT Trials 1-5 Sum
Husted, 2009	CAMH	80	CVLT Trials 1-5 Sum
Chen, 2009	CCNMD	121	CVLT Trials 1-5 Sum
Greenwood, 2013	COGS	949	CVLT Trials 1-5 Sum
Glahn, 2007	GOBS / CVCR	269	CVLT Trials 1-5 Sum
Bertisch, 2010	NAMI	86	CVLT Trials 1-5 Sum
Tuulio-H., 2002	NPHIF	264	CVLT Trials 1-5 Sum
Meta-estimate	**7 Studies**	**2,740**	**CVLT Trials 1-5 Sum**
Chen, 2009	CCNMD	121	WMS Family Pictures IR
Husted, 2009	CAMH	80	WMS Logical Memory DR
Husted, 2009	CAMH	80	WMS Logical Memory IR
Chen, 2009	CCNMD	121	WMS Logical Memory IR
Meta-estimate	**2 Studies**	**201**	**WMS Logical Memory IR**
Bertisch, 2010	NAMI	84	WMS Verbal Paired Associates DR
Bertisch, 2010	NAMI	84	WMS Verbal Paired Associates IR
Meta-estimate	***9 Studies***	***4,757***	***Verbal Memory Domain***

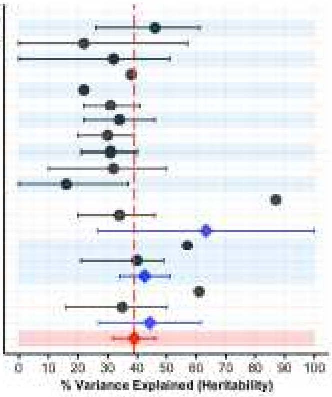


Supplementary Figure 7 – Heritability of Verbal Learning and Memory

Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability of Verbal Learning and Memory based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families; and (C) Schizophrenia Families/Pedigrees. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font). For plotting purposes, the cohort name was truncated for Glahn et al. (GOBS / CVCR / MCM). CVLT Trials 1-5 Sum was obtained from the RAVLT for Husted et al., 2009 and from the BACS List Learning for Hill et al., 2013.
Abbreviations: BACS = Brief Assessment of Cognition in Schizophrenia; CNB = Computerized Neurocognitive Battery; CVLT = California Verbal Learning Test; DR = Delayed Recall; IR = Immediate Recall; RAVLT = Rey Auditory Verbal Learning Test.

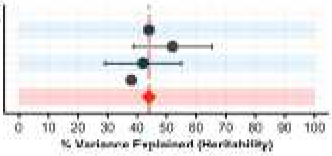
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Johnson, 2007b	MISTRA	252	CAB Associative Memory
Steves, 2013	HATS	488	CANTAB Paired Associates Learning Error
Steves, 2013	HATS	488	CANTAB Pattern Recognition Memory
Finkel, 2000a	SATSA	584	CAP Names & Faces DR
Finkel, 2000a	SATSA	584	CAP Names & Faces IR
Swagerman, 2016	NTR	1,632	CNB Penn Face Memory DR Accuracy
Swagerman, 2016	NTR	1,632	CNB Penn Face Memory IR Accuracy
Swagerman, 2016	NTR	1,632	CNB VOLT DR Accuracy
Swagerman, 2016	NTR	1,632	CNB VOLT IR Accuracy
Johnson, 2007b	MISTRA	252	HFSC Picture Memory DR
Johnson, 2007b	MISTRA	252	HFSC Picture Memory IR
Finkel, 2004	SATSA	1,280	Thurstone Picture Memory
Read, 2006	STR	1,036	Thurstone Picture Memory
Meta-estimate	**2 Studies**	**2,316**	**Thurstone Picture Memory**
Hall, 1996	UPTS	220	WMS Visual Reproduction DR
Kremen, 2014	VETSA	1,228	WMS Visual Reproduction DR
Meta-estimate	**2 Studies**	**1,448**	**WMS Visual Reproduction DR**
Finkel, 1998a	MTSADA	682	WMS Visual Reproduction IR
Kremen, 2014	VETSA	1,228	WMS Visual Reproduction IR
Meta-estimate	**2 Studies**	**1,910**	**WMS Visual Reproduction IR**
Meta-estimate	***8 Studies***	***6,354***	***Non-Verbal Memory Domain***



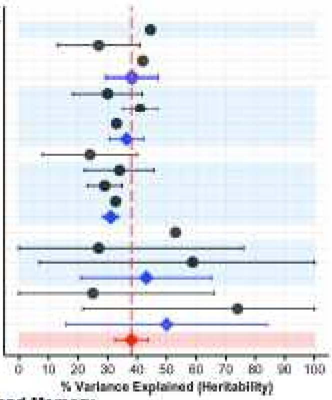
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Glahn, 2013	GOBS	1,129	CNB Penn Face Memory DR
Knowles, 2014	GOBS	1,269	CNB Penn Face Memory IR
Knowles, 2014	GOBS	1,269	Digit Symbol Recall
Glahn, 2013	GOBS	1,129	WAIS Digit Symbol Recall
Meta-estimate	***1 Studies***	***1,199***	***Non-Verbal Memory Domain***



C. Schizophrenia Families

Reference	Cohort	N	Measure
Glahn, 2014	GOBS	1,606	CNB Penn Face Memory DR
Greenwood, 2007	COGS	533	CNB Penn Face Memory IR
Glahn, 2014	GOBS	1,606	CNB Penn Face Memory IR
Meta-estimate	**2 Studies**	**2,139**	**CNB Penn Face Memory IR**
Greenwood, 2013	COGS	912	CNB Penn Face Memory IR + DR
Wiener, 2013	PAARTNERS	1,606	CNB Penn Face Memory IR + DR
Gur, 2007	PMFS	430	CNB Penn Face Memory IR + DR
Meta-estimate	**3 Studies**	**2,948**	**CNB Penn Face Memory IR + DR**
Greenwood, 2007	COGS	520	CNB VOLT Accuracy
Greenwood, 2013	COGS	900	CNB VOLT IR + DR
Wiener, 2013	PAARTNERS	1,606	CNB VOLT IR + DR
Gur, 2007	PMFS	397	CNB VOLT IR + DR
Meta-estimate	**3 Studies**	**2,903**	**CNB VOLT IR + DR**
Glahn, 2007	GOBS / CVCR	269	WAIS Digit Symbol Recall
Husted, 2009	CAMH	80	WMS Visual Reproduction DR
Bertisch, 2010	NAMI	82	WMS Visual Reproduction DR
Meta-estimate	**2 Studies**	**162**	**WMS Visual Reproduction DR**
Husted, 2009	CAMH	80	WMS Visual Reproduction IR
Bertisch, 2010	NAMI	83	WMS Visual Reproduction IR
Meta-estimate	**2 Studies**	**163**	**WMS Visual Reproduction IR**
Meta-estimate	***7 Studies***	***4,772***	***Non-Verbal Memory Domain***



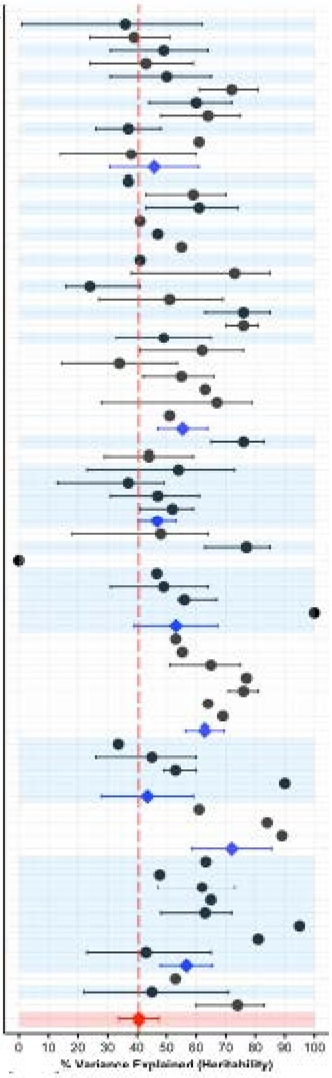
Supplementary Figure 8 – Heritability of Non-Verbal Learning and Memory

Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability for Non-Verbal Learning and Memory based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families, and (C) Schizophrenia Families/Pedigrees. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for

MCM). Abbreviations: CAB = Comprehensive Ability Battery; CANTAB = Cambridge Neuropsychological Test Automated Battery; CAP = Colorado Adoption Project; CNB = Computerized Neurocognitive Battery; DR = Delayed Recall; IR = Immediate Recall; HFSC = Hawaii Family Study of Cognition; VOLT = Visual Object Learning Test.

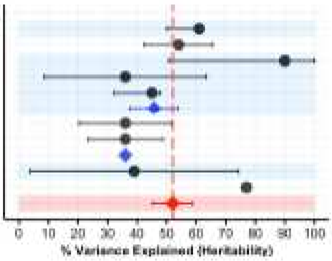
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Vuoksimaa, 2014	VETSA	454	AFQT Verbal ability
Panizzon, 2014	VETSA	1,222	AFQT Vocabulary
Johnson, 2007b	MISTRA	252	CAB Inductive Reasoning
Johnson, 2007b	MISTRA	252	CAB Proverbs
Johnson, 2007b	MISTRA	252	CAB Speed of Closure
Johnson, 2007b	MISTRA	252	CAB Spelling
Johnson, 2007b	MISTRA	252	CAB Vocabulary
Johnson, 2007b	MISTRA	252	CAB Word Fluency
Swagerman, 2016	NTR	1,632	CNB Penn Verbal Reasoning Accuracy
Finkel, 2000a	SATSA	584	DSB Synonyms
Reed, 2006	STR	1,146	DSB Synonyms
Meta-estimate	**2 Studies**	**1,730**	**DSB Synonyms**
Bouchard, 1990b	MISTRA	148	ETS Things
Johnson, 2007b	MISTRA	252	ETS Word Beginnings & Endings
Johnson, 2005	MISTRA	158	HFSC Pedigrees
Neubauer, 2000	GOSAT	600	LPS Closure
Neubauer, 2000	GOSAT	600	LPS Vocabulary1
Neubauer, 2000	GOSAT	600	LPS Vocabulary2
Neubauer, 2000	GOSAT	600	LPS Word Fluency
Bratko, 2010	UOZC	298	MFBT Vocabulary
Rommel, 2015	TEDS	9,542	Mill Hill Vocabulary Scale
Johnson, 2005	MISTRA	158	MISTRA Reading Comprehension
Johnson, 2005	MISTRA	158	MISTRA Spelling
Singer, 2006	TwinsUK	556	NART Reading
Beaver, 2013	NLSAH	4,174	Peabody Picture Vocabulary Test
Giubilei, 2008	ITR	186	Phonemic Fluency
Swan, 2002	NHLBI	316	Phonemic Fluency
Hoekstra, 2009	NTR	558	Phonemic Fluency
Lee, 2012a	OATS	430	Phonemic Fluency
Bratko, 2010	UOZC	298	Phonemic Fluency
Hall, 1996	UPTS	220	Phonemic Fluency
Meta-estimate	**6 Studies**	**2,008**	**Phonemic Fluency**
Johnson, 2007b	MISTRA	252	PMA Vocabulary
Wainwright, 2005b	MAPS	780	QCST Create & Present
Giubilei, 2008	ITR	186	Semantic Fluency
McGue, 2001	LSADT	806	Semantic Fluency
Hoekstra, 2009	NTR	558	Semantic Fluency
Vasilopoulos, 2012a	VETSA	1,238	Semantic Fluency
Meta-estimate	**4 Studies**	**2,788**	**Semantic Fluency**
Hansell, 2015	MAPS	900	Sentence Comprehension
Johnson, 2005	MISTRA	158	Slosson Word Recognition
Giubilei, 2008	ITR	186	Token Test
Friedman, 2008	CLTS	1,164	WAIS Comprehension
Johnson, 2007b	MISTRA	252	WAIS Comprehension
Rijsdijk, 2002	NTR	388	WAIS Comprehension
Tambs, 1984	OTSN	160	WAIS Comprehension
Meta-estimate	**4 Studies**	**1,964**	**WAIS Comprehension**
Friedman, 2008	CLTS	1,164	WAIS Information
Wainwright, 2004	MAPS	1,000	WAIS Information
Johnson, 2007b	MISTRA	252	WAIS Information
Finkel, 1995b	MTSADA	382	WAIS Information
Rijsdijk, 2002	NTR	388	WAIS Information
Tambs, 1984	OTSN	160	WAIS Information
Finkel, 2004	SATSA	1,280	WAIS Information
Meta-estimate	**7 Studies**	**4,626**	**WAIS Information**
Friedman, 2008	CLTS	1,164	WAIS Similarities
Johnson, 2007b	MISTRA	252	WAIS Similarities
Rijsdijk, 2002	NTR	388	WAIS Similarities
Tambs, 1984	OTSN	160	WAIS Similarities
Meta-estimate	**4 Studies**	**1,964**	**WAIS Similarities**
Friedman, 2008	CLTS	1,164	WAIS Verbal Comprehension Index
Posthuma, 2003	NTR	844	WAIS Verbal Comprehension Index
Tambs, 1984	OTSN	160	WAIS Verbal Comprehension Index
Meta-estimate	**3 Studies**	**2,168**	**WAIS Verbal Comprehension Index**
Friedman, 2008	CLTS	1,164	WAIS Vocabulary
Wainwright, 2004	MAPS	1,000	WAIS Vocabulary
Johnson, 2007b	MISTRA	252	WAIS Vocabulary
Volk, 2006	MOAFTS	190	WAIS Vocabulary
van den Berg, 2004	NTR	632	WAIS Vocabulary
Tambs, 1984	OTSN	160	WAIS Vocabulary
Hall, 1996	UPTS	220	WAIS Vocabulary
Vasilopoulos, 2012a	VETSA	1,238	WAIS Vocabulary
Meta-estimate	**8 Studies**	**4,856**	**WAIS Vocabulary**
Finkel, 2000a	SATSA	584	WIT-III Analogies
Kremen, 2005	VETR	692	WRAT Reading
Johnson, 2005	MISTRA	158	WRMT Word Identification
Meta-estimate	***21 Studies***	***24,630***	***Verbal Ability Domain***



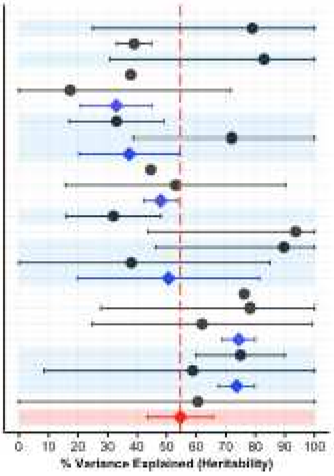
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Luciano, 2010	SFHS	6,118	Mill Hill Vocabulary Scale
Knowles, 2014	GOBS	1,269	Phonemic Fluency
Chen, 2009	CCNMD	157	Semantic + Phonemic Fluency
Greenwood, 2011	CVCR	253	Semantic + Phonemic Fluency
Luciano, 2010	SFHS	6,118	Semantic + Phonemic Fluency
Meta-estimate	**3 Studies**	**6,528**	**Semantic + Phonemic Fluency**
Steegers, 2007	ERF	780	Semantic Fluency
Knowles, 2014	GOBS	1,260	Semantic Fluency
Meta-estimate	**2 Studies**	**2,040**	**Semantic Fluency**
Greenwood, 2011	CVCR	253	WAIS Similarities
Glahn, 2013	GOBS	1,129	WAIS Vocabulary
Meta-estimate	***5 Studies***	***8,630***	***Verbal Ability Domain***



C. Schizophrenia Families

Reference	Cohort	N	Measure
Bertisch, 2010	NAMI	83	Boston Naming Test
Wiener, 2013	PAARTNERS	1,606	CNB Penn Verbal Reasoning Accuracy
Bertisch, 2010	NAMI	85	Peabody Picture Vocabulary Test
Glahn, 2007	GOBS / CVCR	269	Phonemic Fluency
Bertisch, 2010	NAMI	84	Phonemic Fluency
Meta-estimate	**2 Studies**	**353**	**Phonemic Fluency**
Hill, 2013	B-SNIP	971	Semantic + Phonemic Fluency
Chen, 2009	CCNMD	121	Semantic + Phonemic Fluency
Meta-estimate	**2 Studies**	**1,092**	**Semantic + Phonemic Fluency**
Glahn, 2007	GOBS / CVCR	269	Semantic Fluency
Aukes, 2008	UMCU	180	Semantic Fluency
Meta-estimate	**2 Studies**	**449**	**Semantic Fluency**
Hill, 2013	B-SNIP	971	Token Test
Bertisch, 2010	NAMI	85	WAIS Information
Bertisch, 2010	NAMI	85	WAIS Similarities
Tuulio-H., 2002	NPHIP	263	WAIS Similarities
Meta-estimate	**2 Studies**	**348**	**WAIS Similarities**
Glahn, 2014	GOBS	1,606	WAIS Vocabulary
Bertisch, 2010	NAMI	85	WAIS Vocabulary
Tuulio-H., 2002	NPHIP	264	WAIS Vocabulary
Meta-estimate	**3 Studies**	**1,955**	**WAIS Vocabulary**
Hill, 2013	B-SNIP	971	WRAT Reading
Bertisch, 2010	NAMI	85	WRAT Reading
Meta-estimate	**2 Studies**	**1,056**	**WRAT Reading**
Bertisch, 2010	NAMI	86	WRAT Spelling
Meta-estimate	***8 Studies***	***5,102***	***Verbal Ability Domain***

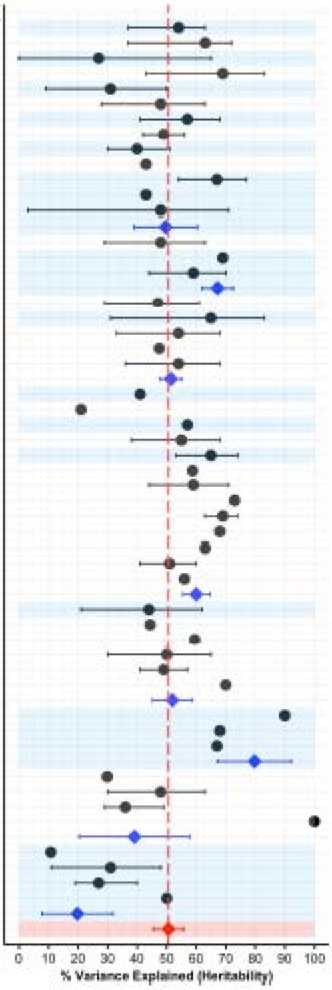


Supplementary Figure 9 – Heritability of Verbal Ability

Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability for Verbal Ability based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families, and (C) Schizophrenia Families/Pedigrees. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font). For plotting purposes, the cohort name was truncated for Glahn et al. (GOBS / CVCR / MCM).
Abbreviations: CAB = Comprehensive Ability Battery; CNB = Computerized Neurocognitive Battery; DSB = Dureman-Sälde Battery; ETS = Educational Testing Service; LPS = Leistungsprüfsystem; NART = National Adult Reading Test; WRAT = Wide Range Achievement Test.

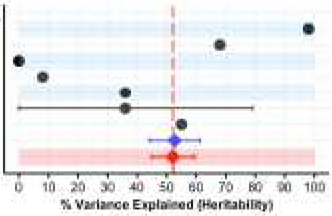
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Panizzon, 2014	VETSA	1,222	AFQT Box Folding
Vuoksimaa, 2014	VETSA	454	AFQT Spatial Processing
Vuoksimaa, 2014	VETSA	454	AFQT Tool+Mechanical Reasoning
Giubilei, 2008	ITR	186	BVRT Copying Drawings
Johnson, 2007b	MISTRA	252	CAB Flexibility of Closure
Johnson, 2007b	MISTRA	252	CAB Mechanical Ability
Johnson, 2007b	MISTRA	252	CAB Spatial Ability
Swagerman, 2016	NTR	1,632	CNB JOLO Accuracy
Swagerman, 2016	NTR	1,632	CNB Penn Matrix Reasoning Accuracy
Finkel, 2000a	SATSA	584	DSB Figure Logic
Johnson, 2007b	MISTRA	252	ETS Card Rotations
Finkel, 2000a	SATSA	584	ETS Card Rotations
Bratko, 2010	UOZC	298	ETS Card Rotations
Meta-estimate	**3 Studies**	**1,134**	**ETS Card Rotations**
Johnson, 2007b	MISTRA	252	ETS Cube Comparisons
Friedman, 2008	CLTS	1,164	ETS Hidden Patterns
Johnson, 2007b	MISTRA	252	ETS Hidden Patterns
Meta-estimate	**2 Studies**	**1,416**	**ETS Hidden Patterns**
Johnson, 2007b	MISTRA	252	ETS Paper Folding
Bratko, 2010	UOZC	298	ETS Surface Development
Vuoksimaa, 2010	FinnTwin12	716	HFSC Mental Rotation
Suzuki, 2011	KTP	638	HFSC Mental Rotation
Johnson, 2007b	MISTRA	252	HFSC Mental Rotation
Meta-estimate	**3 Studies**	**1,606**	**HFSC Mental Rotation**
Hall, 1996	UPTS	220	JOLO Accuracy
Neubauer, 2000	GOSAT	600	LPS Embedded Figures Test
Wainwright, 2004	MAPS	1,000	MAB Spatial
Johnson, 2007b	MISTRA	252	Minnesota Paper Form Board
Panizzon, 2014	VETSA	1,222	Thurstone Hidden Figures Test
Friedman, 2008	CLTS	1,164	WAIS Block Design
Johnson, 2007b	MISTRA	252	WAIS Block Design
Finkel, 1995b	MTSADA	382	WAIS Block Design
Rijsdijk, 2002	NTR	388	WAIS Block Design
Tambs, 1984	OTSN	160	WAIS Block Design
Finkel, 2004	SATSA	1,280	WAIS Block Design
Reed, 2006	STR	1,210	WAIS Block Design
Hall, 1996	UPTS	220	WAIS Block Design
Meta-estimate	**8 Studies**	**5,056**	**WAIS Block Design**
Vasilopoulos, 2012a	VETSA	1,238	WAIS Matrix Reasoning
Friedman, 2008	CLTS	1,164	WAIS Object Assembly
Wainwright, 2004	MAPS	1,000	WAIS Object Assembly
Johnson, 2007b	MISTRA	252	WAIS Object Assembly
Rijsdijk, 2002	NTR	388	WAIS Object Assembly
Tambs, 1984	OTSN	160	WAIS Object Assembly
Meta-estimate	**5 Studies**	**2,964**	**WAIS Object Assembly**
Friedman, 2008	CLTS	1,164	WAIS Perceptual Organization Index
Posthuma, 2003	NTR	844	WAIS Perceptual Organization Index
Tambs, 1984	OTSN	160	WAIS Perceptual Organization Index
Meta-estimate	**3 Studies**	**2,168**	**WAIS Perceptual Organization Index**
Friedman, 2008	CLTS	1,164	WAIS Picture Arrangement
Johnson, 2007b	MISTRA	252	WAIS Picture Arrangement
Rijsdijk, 2002	NTR	388	WAIS Picture Arrangement
Tambs, 1984	OTSN	160	WAIS Picture Arrangement
Meta-estimate	**4 Studies**	**1,964**	**WAIS Picture Arrangement**
Friedman, 2008	CLTS	1,164	WAIS Picture Completion
Johnson, 2007b	MISTRA	252	WAIS Picture Completion
Rijsdijk, 2002	NTR	388	WAIS Picture Completion
Tambs, 1984	OTSN	160	WAIS Picture Completion
Meta-estimate	**4 Studies**	**1,964**	**WAIS Picture Completion**
Meta-estimate	***15 Studies***	***9,361***	***Visuospatial Ability Domain***



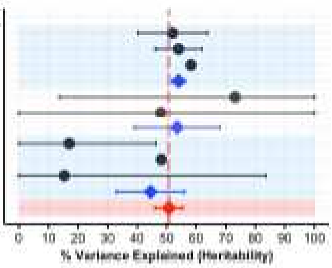
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Smalley, 1989	UCLA	73	ETS Card Rotations
Smalley, 1989	UCLA	73	ETS Cube Comparisons
Smalley, 1989	UCLA	73	ETS Hidden Patterns
Smalley, 1989	UCLA	73	HFSC Mental Rotation
Smalley, 1989	UCLA	73	LPS Embedded Figures Test
Chen, 2009	CCNMD	157	WAIS Matrix Reasoning
Glahn, 2013	GOBS	1,129	WAIS Matrix Reasoning
Meta-estimate	**2 Studies**	**1,286**	**WAIS Matrix Reasoning**
Meta-estimate	***3 Studies***	***1,359***	***Visuospatial Ability Domain***



C. Schizophrenia Families

Reference	Cohort	N	Measure
Greenwood, 2013	COGS	837	CNB JOLO Accuracy
Wiener, 2013	PAARTNERS	1,606	CNB JOLO Accuracy
Gur, 2007	PMFS	419	CNB JOLO Accuracy
Meta-estimate	**3 Studies**	**2,862**	**CNB JOLO Accuracy**
Bertisch, 2010	NAMI	69	WAIS Block Design
Tuulio-H., 2002	NPHIF	245	WAIS Block Design
Meta-estimate	**2 Studies**	**314**	**WAIS Block Design**
Chen, 2009	CCNMD	121	WAIS Matrix Reasoning
Glahn, 2014	GOBS	1,606	WAIS Matrix Reasoning
Bertisch, 2010	NAMI	86	WAIS Matrix Reasoning
Meta-estimate	**3 Studies**	**1,813**	**WAIS Matrix Reasoning**
Meta-estimate	***7 Studies***	***4,912***	***Visuospatial Ability Domain***



Supplementary Figure 10 – Heritability of Visuospatial Ability

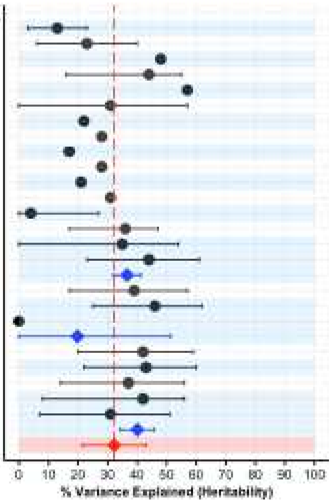
Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability for Visuospatial Ability based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families; and (C) Schizophrenia Families.

The WAIS Object Assembly measure for Wainwright et al. (2004) was obtained from the MAB Object subtest, which correlates highly with the WAIS Object Assembly subtest. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font). For plotting purposes, the cohort name was truncated for Glahn et al. (GOBS / CVCR / MCM).

Abbreviations: BVRT = Benton Visual Retention Test; CAB = Comprehensive Ability Battery; CNB = Computerized Neurocognitive Battery; DSB = Dureman-Sälde Battery; ETS = Educational Testing Service; HFSC = Hawaii Family Study of Cognition; JOLO = Judgment of Line Orientation; LPS = Leistungsprüfsystem; MAB = Multidimensional Aptitude Battery; WAIS = Wechsler Adult Intelligence Scale.

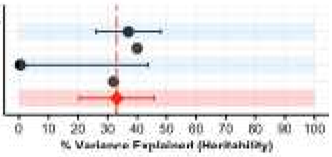
A. Non-Psychiatric Twins

Reference	Cohort	N	Measure
Swagerman, 2016	NTR	1,632	CNB PCET Accuracy
Posthuma, 2002b	NTR	472	Flanker % Errors Congruent Stimuli
Friedman, 2008	CLTS	1,164	Go-No-Go Stop Signal (No Go) RT
Hansell, 2015	MAPS	900	Latin Square task
Neubauer, 2000	GOSAT	600	LPS Reasoning
Hansell, 2015	MAPS	900	N-term task
Kremen, 2009	VETR	690	Tower of London 1 Efficiency
Kremen, 2009	VETR	690	Tower of London 1 RT
Kremen, 2009	VETR	690	Tower of London 2 Efficiency
Kremen, 2009	VETR	690	Tower of London 2 Number Attempts
Kremen, 2009	VETR	690	Tower of London 2 Planning Time
Kremen, 2009	VETR	690	Tower of London 2 RT
Anokhin, 2003	MTR	166	WCST Failure to Maintain Set
Godinez, 2012	CLTS	792	WCST Non-perseverative Errors
Godinez, 2012	CLTS	792	WCST Perseverative Errors
Anokhin, 2003	MTR	166	WCST Perseverative Errors
Meta-estimate	**2 Studies**	**958**	**WCST Perseverative Errors**
Anokhin, 2003	MTR	166	WCST Perseverative Errors %
Anokhin, 2003	MTR	166	WCST Perseverative Responses
Hall, 1996	UPTS	220	WCST Perseverative Responses
Meta-estimate	**2 Studies**	**386**	**WCST Perseverative Responses**
Anokhin, 2003	MTR	166	WCST Perseverative Responses %
Anokhin, 2003	MTR	166	WCST Total Errors
Anokhin, 2003	MTR	166	WCST Total Errors %
Godinez, 2012	CLTS	792	WCST Trials to 1st Category
Anokhin, 2003	MTR	166	WCST Trials to 1st Category
Meta-estimate	**2 Studies**	**958**	**WCST Trials to 1st Category**
Meta-estimate	***7 Studies***	***4,513***	***Executive Function Domain***



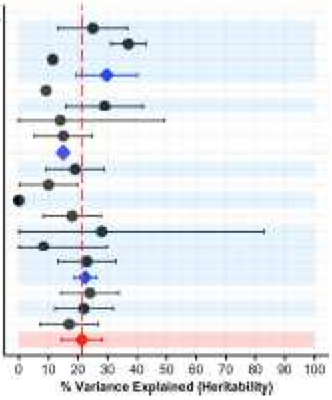
B. Non-Psychiatric Families

Reference	Cohort	N	Measure
Knowles, 2014	GOBS	1,269	CNB PCET Accuracy
Galimberti, 2013	INSPE	58	IGT Advantageous Deck Selection
Chen, 2009	CCNMD	157	WCST Perseverative Errors
Galimberti, 2013	INSPE	58	WCST Perseverative Errors %
Meta-estimate	***3 Studies***	***1,484***	***Executive Function Domain***



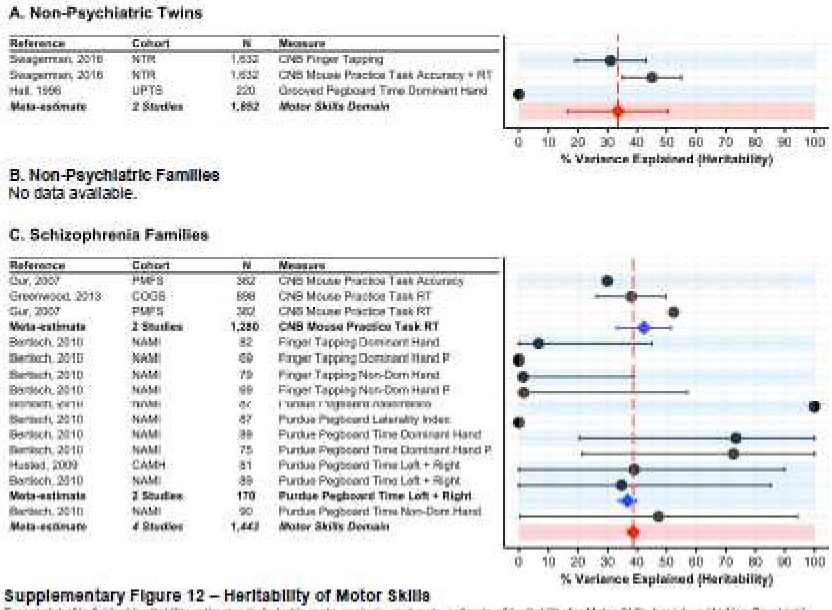
C. Schizophrenia Families

Reference	Cohort	N	Measure
Greenwood, 2013	COGS	888	CNB PCET Accuracy
Wiener, 2013	PAARTNERS	1,606	CNB PCET Accuracy
Gur, 2007	PMFS	409	CNB PCET Accuracy
Meta-estimate	**3 Studies**	**2,903**	**CNB PCET Accuracy**
Glahn, 2014	GOBS	1,606	CNB PCET Categories Achieved
Hill, 2013	B-SNIP	971	Tower of London
Husted, 2009	CAMH	81	WCST Categories Completed
Lin, 2013	MPSS / TSLS	2,300	WCST Categories Completed
Meta-estimate	**2 Studies**	**2,381**	**WCST Categories Completed**
Lin, 2013	MPSS / TSLS	2,300	WCST Conceptual Level Responses
Lin, 2013	MPSS / TSLS	2,300	WCST Failure to Maintain Set
Lin, 2013	MPSS / TSLS	2,300	WCST Learning to Learn
Lin, 2013	MPSS / TSLS	2,300	WCST Non-perseverative Errors
Husted, 2009	CAMH	81	WCST Perseverative Errors
Chen, 2009	CCNMD	121	WCST Perseverative Errors
Lin, 2013	MPSS / TSLS	2,300	WCST Perseverative Errors
Meta-estimate	**3 Studies**	**2,502**	**WCST Perseverative Errors**
Lin, 2013	MPSS / TSLS	2,300	WCST Perseverative Responses
Lin, 2013	MPSS / TSLS	2,300	WCST Total Errors
Lin, 2013	MPSS / TSLS	2,300	WCST Trials to 1st Category
Meta-estimate	***8 Studies***	***7,982***	***Executive Function Domain***



Supplementary Figure 11 – Heritability of Executive Function

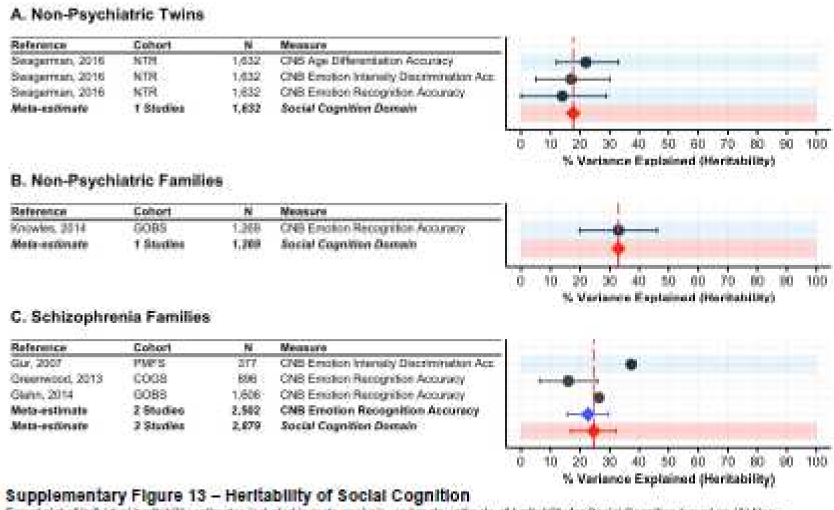
Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability for Executive Functioning based on (A) Non-Psychiatric Twins; (B) Non-Psychiatric Families; and (C) Schizophrenia Families/Pedigrees. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font). For plotting purposes, the cohort name was truncated for Lin et al. (MPSS / TSLS / SEFOS). Abbreviations: CNB = Computerized Neurocognitive Battery; IGT = Iowa Gambling Task; PCET = Penn Conditional Exclusion Test; LPS = Leistungsprüfsystem; RT = Reaction Time; WCST = Wisconsin Card Sorting Test.



Supplementary Figure 12 – Heritability of Motor Skills

Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability for Motor Skills based on (A) Non-Psychiatric Twins, (B) Non-Psychiatric Families, and (C) Schizophrenia Families/Pedigrees. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font).

Abbreviations: CNB = Computerized Neurocognitive Battery; P = Percentile; RT = Reaction Time



Supplementary Figure 13 – Heritability of Social Cognition

Forest plot of individual heritability estimates included in meta-analysis, and meta-estimate of heritability for Social Cognition based on (A) Non-Psychiatric Twins, (B) Non-Psychiatric Families, and (C) Schizophrenia Families/Pedigrees. The subject number of the overall domain estimate (bold italic) is the sum of subject numbers across all independent cohorts in the plot (plain font), some of which are also included in the meta-estimate for one or more individual neuropsychological tests (bold font).

Abbreviations: CNB = Computerized Neurocognitive Battery

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